User-centered Service Design for Sustainable Mobility Innovations
Mapping Users’ Needs and Service Requirements for Electric Car Sharing Service Design

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Mapping users’ needs and service requirements for electric car sharing service design

LIRIDONA SOPJANI

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**Abstract**

Electric car sharing is gradually expanding as an innovative and more sustainable mobility alternative to private cars. Though, the use of such mobility service has not yet reached the desired levels worldwide despite attracting large number of customers. For car sharing operators, thus, it is imperative to understand the users and their needs beyond the existing demographics and quantitative data in order to design more desirable and useful services that expand customer acceptance and usage rate of such alternative.

This thesis is an exploratory study about users’ needs, behaviors, and experiences toward electric car sharing and the service requirements resulting from these dimensions. Using user-centered service design approach, the study focuses in obtaining qualitative insights about users through workshops with focus groups in regards to LEV-pool, a research project that intends to field test a new approach to car sharing by offering small size electric vehicles for local mobility at a large workplace.

Based on three user-centered service design methods: customer journey map, personas, and stakeholder map, a visual mapping of users, their needs, behaviors, and experiences, and service requirements is developed. The findings point at different user types with distinct purposes of using car sharing, whose needs for mobility (at work) are affected by external factors such as work activities and job occupation. Their mobility behavior differs in terms of how they interact with car sharing service and is partly influenced by the service offering. In general, users show various experiences toward car sharing systems, and many relate it to technical aspects of the service. In terms of service requirements, the results highlight available vehicles at the needed time, simple and easy booking system with many features responsive to users’ needs, maintenance and cleanliness of vehicles, effective communication of service offering, and simple pricing schemes. The underlying user dimensions explored show as relevant in shaping the users’ evaluation of a service and their decision to use a certain mobility alternative.

**Keywords:** Sustainable Development, Service Design, electric car sharing, user needs, sustainable mobility, innovation

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Summary

Electric car sharing offers a more sustainable mobility alternative to private cars. Though, the use of this service has not yet reached the desired levels worldwide despite attracting large number of customers. For car sharing operators, thus, it is imperative to understand the users and their needs in order to design more desirable and useful electric car sharing services.

This thesis is an exploratory study of the users and the service of electric car sharing systems. Using user-centered service design approach, the study focuses in obtaining qualitative insights about users in regards to LEV-pool –a research project that intends to field test a new approach to car sharing by offering small size electric vehicles for local mobility at a large workplace. The study applies three user centered service design methods to capture and present a holistic understanding of users, their needs, behaviors, and experiences toward electric car sharing and the service requirements resulting from these dimensions.

The findings suggest that users are distinct and have different needs for mobility (at work), which are shaped by the external factors such as work activities and job occupation. Their mobility behavior differs in terms of how they interact with car sharing service and is partly influenced by the service offering. In general, users have various experiences toward car sharing systems, and many relate it to technical aspects of the service. By exploring the users, the results point directly to different requirements that the service shall meet for it to enhance usage such as available vehicles at the needed time, simple and easy booking system with many features responsive to users’ needs, maintenance and cleanliness of vehicles, effective communication of service offering, and simple pricing schemes.

Keywords: Sustainable Development, Service Design, electric car sharing, user needs, sustainable mobility, innovation

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1. Introduction

1.1. Electric Car Sharing Concept

The concept of car sharing has gained much public attention recently. Not owning a car while having the flexibility to use a car whenever needed proposes an attractive mode for mobility in terms of sustainable urban development. In a broad definition, car sharing provides a mobility alternative to users through a shared-use fleet paid based on time and miles traveled (Shaheen et al. 2004; Yoon 2014). The combination of this alternative with electric vehicles (EVs) is a new innovative approach to urban mobility (Habib et al. 2012). Electric vehicles (EVs) emit less greenhouse gases, thus, making them a more sustainable transportation mode (Yoon 2014). The concept is considered as a potential alternative that may hinge many urban issues such as traffic congestion, pollution, and noise by promoting a sustainable and environmentally friendly transport solution (Firnkorn & Müller 2011; Huwer 2004; Katzev 2003; Luè et al. 2012; Martin & Shaheen 2011; Musso et al. 2012; Yoon 2014). In the long run, car sharing may reduce private car ownership and ridership, economic costs for individuals, but also increase the use of public transport in urban settings and beyond.

“Travelers could benefit by gaining the mobility of a car without carrying the full costs of ownership; transit operators might benefit by tapping a much larger potential market; and society might benefit by diverting travelers from single-occupant vehicles to transit for part of their trips” (Shaheen 2004, p.1).

Indeed, car sharing is a peculiar concept in the sense that it proposes a change of a long-lived social norm – car ownership. As Katzev (2003, p. 68) asserts “car sharing divorces the notion of automobile use from ownership by providing individuals with convenient access to a shared fleet of vehicles, rather than a single privately owned one.” There is a noted trend among observers in which society is moving from a market-based economy toward an era where ‘access’ to things is becoming more prevalent than ‘possessing’ or ‘owning’ them (Katzev 2003, p. 68). “Instead of buying and owning things, consumers want access to goods and prefer to pay for the experience of temporarily accessing them” (Bardhi & Eckhardt 2012, p.881). Car sharing is one of the many access models that have already existed for ages i.e. bike sharing programs, libraries, online movie borrowing platforms, fashion and jewelry among others.

Electric car sharing can be defined as a Product-Service System (PSS) (Meijkamp and Theunissen 1992; Mont 2004; Schaeferers 2013,). Offering mobility service through electric vehicles (EVs) can both drive increased use of the EV as a car, and the service as part of the system (Yoon 2014). Various service models of car sharing exist around the world. A widely known model is the neighborhood car sharing system, where members can have easy access by being provided with vehicles (free-floating fleet or fixed station fleet comprised of electric vehicles or others) for in near locations (Shaheen et al. 2004). Another approach is the commuter car-sharing model with link to transit and workplace studied by Shaheen et al. (2001), Firnkorn & Müller (2011), Huwer (2004), Luè et al. (2012). This model intends to connect short-term rental cars to public transport and employment centers. The system enables users to access public transport by commuting to work or vice versa through renting an electric car which can be parked at designated stations to be used during the day by employees in the area, and then upon return the user can pick it up for night use or weekend (Shaheen et al. 2004). An important practical aspect about this model is the convenience and flexibility offered to the user, but also putting into use vehicles in contrast to private cars, which would remain idle during the day and take parking space (Shaheen et al. 2004).
Despite its innovativeness and attracting large numbers of customers, such mobility mode has not yet reached the desired levels of usage (Shaheen & Cohen 2007). One reason is that the concept of electric car sharing is still new and evolving and the market has not yet reached its potential (Luè et al. 2012, Nobis 2006). Few studies have focused in investigating this mobility alternative from a user-centered approach, to understand the users, their needs, and the underlying factors influencing their decision to use this mobility alternative. Though, much analysis has been done on car sharing effects in travel behavior of users and potential users by Bamberg et al. (2011), Costain et al. (2012), Kearney & De Young (1996), Luca & Pace (2015), Shaheen et al. (2004), Schaefer (2013), Van Acker et al. (2014). Changing users behavior, adaptation to car sharing, users’ travel patterns, users’ attitudes, and lately motives for usage have been scientifically investigated by these researchers.

1.2. LEV-pool Project

In 2014, the Integrated Transport Research Lab (ITRL), one of the research centers at the Royal Institute of Technology (KTH) in Stockholm, begun a research project called LEV-pool together with several partners IKEA, Botkyrka Municipality, Hertz, Gröna Bilister, EcoTraffic, Seamless and Renault. The project intends to field test and evaluate a mobility alternative, where small size electric vehicles will be made available for local mobility at a large workplace. The aim of the project is to introduce and offer a local mobility solution for daily commuters at work, while encouraging the use of public transport to and from work (LEVpool Preliminary Study 2014).

LEV-pool is a new approach to car sharing for it integrates small light weight electric vehicles and intends to offer a distinct service. These vehicles are suitable for short term mobility and they have low environmental impact but also offer good economy. The solution provides an inexpensive mobility service for the user with good economy for the fleet owner (ibid.). Since the focus is on local passenger transport, the use of energy efficient small electric vehicles is a reasonable choice (ibid.). Of course the intention is to not replace the use of public transport, bicycle, or walking with electric vehicles, rather foster the combination of those while reducing the use of private cars dependent on fossil fuels (ibid.). The small light weight electric vehicle seems an optimal size with minimal energy consumption and provides maximum CO₂ reduction throughout the life cycle of the product (ibid.).

The service that will be offered is based on a multi-use model with daytime users and morning/evening users (in the project referred as ‘parent users’, in Swedish: fodervärd). The distinctive feature of LEV-pool is that the morning/evening users will have the possibility to ‘own’ the vehicle during evenings and weekends by being a ‘parent’ user, whereas in the mornings they can commute to work with it and pick it up in the evening to go back home. This concept targets individuals who have regular local and at work commuting needs but currently use private fossil fueled car for mobility (ibid.). Additionally, the model offers two way (A-A) and one-way (A-B) mobility service so as to increase the number of users per vehicle. The goal is to reduce the use of private fossil fueled cars for short way commutes i.e. home to a commuting station and business travel between offices locally i.e. 10 km range (ibid.). An additional distinct feature of the model is to allow high occupancy and use of vehicles, which normally would be used only parts of the day. An advantage will be the short notice for borrowing option, whereby users can almost make spontaneous use similar to how they would use their own car (ibid.). The service model resembles to bike sharing/renting which are available at various places across the city and where the user, through purchasing a season pass, can get short-term loan bikes, which can be left at any drop-off point. The service offers daytime booking within short notice, and morning/evening booking with appointment.
The preliminary study for this concept has also shown an attractive business model. The multiple-use approach indicates that the vehicles may have high occupancy rate, thus generating more revenues for the fleet owner (ibid.). It is expected that the CO$_2$ emissions will nearly reach ‘zero level’ for specific journeys made with these vehicles and a 70% shift of occupational and private transport with regards to the targeted users even if they have a fossil-fuel car left at home (ibid.). If enough flexibility is offered to the user, that is allowing users to get quick access to the car when they need it, the project can have substantial impact in the development and use of electric cars for short term mobility needs (ibid.). A great focus throughout the project however, is the design of the LEV-pool service, where much research will be carried out in exploring users and their behavior, the business model, and the impact of the new pool service. Creating better incentives for reaching high usage rate of this mobility alternative while engineering the service around users needs and behaviors is a key approach of the project.

1.3. Purpose of the Study

This master thesis intends to contribute to the LEV-pool project in the part of the service design research for this concept. The purpose of this study is to explore the users’ needs, behaviors, and experiences toward such car sharing concept and the service requirements resulting from these dimensions. To fully expand customer acceptance and encourage people to use LEV-pool for local mobility, it is important to search beyond demographics and quantitative data on users. “Consumer research has shown that investigating aspects not directly observable—such as personality traits, attitudes, or motives—can support in successfully configuring product and service offerings” (Schaefers 2013, p.70). Service design studies highlight the intangible variables such as behaviors, motives, and experiences as important insights to understand users and their needs with regards to a service (Stickdorn & Schneider 2010). Existing research, nonetheless, has been extensively focusing on quantitative analysis of car sharing usage data and related aspects (Schaefers 2013, p.69).

Meanwhile such analysis has contributed to the improvement and innovation of shared-use systems, omitting intangible user dimensions may have neglected the understanding of other influential factors shaping users’ decisions. As such, exploring users’ needs in terms of dimensions such as behaviors, experiences (including attitudes, motives, and expectations) can reveal understanding of the relevant determinants to use car-sharing systems and evaluate service requirements that relate to them. These dimensions may influence the way users evaluate a service or product, affect their choices, and shape their decision to use or not to use a certain innovative alternative. An innovation, based on the ‘Diffusion of Innovation’ model developed by Rogers (1983) becomes a novel solution once the prospective users have come to know about the service, valued and assessed it, have understood how to use it and tested it, subsequently becoming users (Koch 2001, Huwer 2004). Nevertheless if the service is not easy to use and convenient for the people, it will not be desirable for the majority (Norman 2010). Though, engineering a service around the users is also a complex task which requires many considerations in terms of the service offering, how users interact and use the service, the means of communicating with users, and every component of it from first contact to delivery. Particularly car sharing with electric vehicles involves few service peculiarities, which may be limiting the provision of a service that users need and desire.

Building on the theoretical foundation of user-centered service design approach and literature studies, this thesis explores both the users and the service of electric car sharing systems. By developing a visual mapping of the users, their needs, behaviors, and experiences, this thesis intends to gain a deeper understanding of these underlying user dimensions and service
requirements resulting from them, which may influence the use of the LEV-pool service. Such visual mapping is an attempt to apply three user-centered service design methods, which stipulate capturing and presenting a holistic understanding of users and intangible variables that may affect their choice regarding the use of a certain service.

The questions examined throughout the study include:

- What are the users’ needs with regards to sustainable mobility innovations such as car sharing?
- What are the users’ needs in terms of LEV-pool car sharing concept?
- What are the service requirements in terms of the LEV-pool service design to satisfy the users’ needs?

1.4. Mobility with Electric Car Sharing - Relevance to Sustainable Development

With the increasing population in cities worldwide, urban mobility is becoming a critical challenge (UNEP 2015). The need for alternative solutions to mobility related issues rises with such phenomena (Firnkorn & Müller 2011). Together with population growth, urbanization perpetuates, whereby simultaneously affecting the movement of people and goods. In the context of mobility, this is translated to a quadruple in the fleet of vehicles worldwide -700 million cars alone in 2010 compared to 70 million vehicles in 1950s (UNEP 2010 see Firnkorn & Müller 2011, p. 1519). Additionally, the estimates point out that over 60% of people will be living in cities by 2030 (UN Water Decade Programme 2010). The rise of population in urban settings may imply that the motorization rates in cities are increasing too. In spite of public transport support, policies, and incentives, private car ridership and ownership remain high in numbers. The consequences of such phenomena are many such as perpetuating CO₂ emissions, deteriorating air quality, escalating traffic congestion, and increasing demand for parking spaces among others. These issues all pose significant implications for the livelihoods in cities and sustainable urban development, whereby mobility alternatives become a necessity and yet a growing urgency. Seeing these long-term trends, shifting focus to research in mobility alternatives to meet the demand of growing populations should be considered in the perspective of sustainable transport alternatives. There have been many strategic attempts to alleviate mobility challenges, as Yoon (2014) and Katzev (2003) mention, from improved and integrated transportation options, parking management, vehicle registration quotas, license plate based travel restrictions, and many incentives aimed at reducing driving. In many cases, these strategies, although effective, did not reach the desired results.

Narrowing the perspective to Sweden, there are high expectations that in the next thirty years mobility needs will grow substantially due to increase in population and disposable income of people (Office of Regional Planning and Urban Transportation 2006, p.9). In the region of Stockholm, around 920,000 out of 1.9 million citizens travel each day to work (ibid.). On average, 44 percent travel by public transport, whereas 38 percent of them travel by private car (ibid.). Most of the trips, 80 percent, are work related (ibid.). Considering these statistics, it becomes imperative to find innovative approaches to mobility alternatives that focus on the percentage of people using private cars for travelling, and particularly in those performing daily commutes to work. Car sharing, as such, is regarded as a sustainable mobility solution with high potential to serve many people and fill an important gap in transport modes –the gap between public transport and private car (Fellows & Pittfield 2000; Firnkorn & Müller 2011; Huwer 2004; Katzev 2003; Luè et al. 2012; Musso et al. 2012). Sustainability of
mobility solutions in this context is interpreted as accessible and serve the needs of people, enhance mobility in the long term, conserve use of resources and are efficient in its all endeavors from services, machinery, equipment and infrastructure, and human resources. In a broader context, sustainable transport should provide a great value to society, economy and the environment (European Commission 2009).

Literature shows that car sharing can contribute to lower total CO₂ emissions by reducing the vehicle-kilometers travelled (Shaheen et al. 2009), thus ascribing positive environmental effects (Shaheen & Cohen 2007), usually referred in terms of total kilometers driven in private car versus in car sharing (Firnkorn & Müller 2011). Such alternative has shown to also decrease average number of cars needed per household (Martin & Shaheen 2011). Some authors also point out to the changing patterns in behavior toward owning a private car or reducing private ridership and the increased interdependence with public transit (Firnkorn & Müller 2011). Additionally, some studies show that car sharing may reduce the number of cars parked and circulating in the cities (Martin & Shaheen 2011), while as well encouraging walking, cycling, and use of public transport indirectly (Shaheen 2004). Focusing on electric car sharing proposes even higher potential for mitigating environmental concerns such as greenhouse gases (Shaheen et al. 2009).

1.5. Structure of the Study
This thesis intends, overall, to develop a visual mapping of the users’ needs, behaviors, and experiences toward LEV-pool car sharing service concept and service requirements affected from these user dimensions respectively, by taking on a user-centered service design approach. Such approach is necessary before the field-testing the LEV-pool concept. To reach this objective, the study uses analysis, data, and findings from the literature studies and theoretical frameworks as the primary method of research. Additionally, existing data on the users where LEV-pool is to be tested and similar case studies are used to get more insights into the project. Meanwhile, as part of the research methodology, three workshops with focus groups are conducted, whose results are used to exemplify the research questions and develop the visual maps. The general focus of the project will be the service model for the Botkyrka Municipality, a suburban region of Stockholm where this innovative mobility alternative will be tested, and for which more data is available on the demographics, place, users and their travel behavior.

The structure of the thesis follows (see Figure 1 below for a visual representation of the structure):

The first chapter outlines the concept of car sharing and its relevance to sustainable development with regards to sustainable mobility and transport solutions. The purpose of this study is presented here as well.

Chapter two presents the analysis derived from the literature studies on electric car sharing worldwide while focusing on the car sharing service models and challenges related to the design of various service models. A synthesis of different studies is also made to understand better the requirements necessary to design such mobility service. Additionally, literature is presented on the user’s needs aspect and particularly their behaviors, experiences, attitudes, motives, and expectations are examined

Chapter three explores the theoretical framework for service design and how some tools are important for gaining insights onto the user dimensions and service requirements, which enable designers to understand and examine them. Three methods for understanding users’ needs and service requirements are used. These are Customer Journey Map, Personas, and
Stakeholder Map. The data collection approach to this study is described as well, whereby; the topic is analyzed in the actual context of the project involving users, researchers (designers), and stakeholders as focus groups. Three experimental workshops integrating the three service design methods have been conducted with focus groups and are presented here.

Chapter four presents the synthesis of findings from the workshops and analysis is made based on the approach used. Here, visual maps of the results and analysis are presented which depict users’ needs and service requirements.

Chapter five provides a discussion on the results and findings of the study based on the approach of this thesis.

Finally, in chapter six, a conclusion is made where limitations of the study are also addressed and some recommendations on further analysis are proposed.

Figure 1. Visual representation of the structure of the thesis
2. Frame of Reference

2.1. Electric Car Sharing Studies

Research and development in electric car sharing/pooling concept and service models designed around this concept is taking place worldwide. Car sharing systems have been developed in almost all European countries, US (mainly in North America), Israel, Japan, Singapore, China, Malaysia, Australia and other countries (Efthymiou 2013). The use of such systems reaches a number around 348,000 members with services operating in 600 cities of 18 countries (Shaheen & Cohen 2007, p.81). Shaheen and Cohen (2007) provide a retrospective study of ten years car sharing concept worldwide evolution in different aspects. They allege that in the realms of climate change and rising fuel prices, car sharing promises further innovations in terms of models and approaches (ibid.). Market diversification is upscaling as competition evolves and more people become aware and accept this innovative solution (Shaheen et al. 2009, Shaheen & Cohen 2007).

For example, in Switzerland, where the concept first evolved (Katzev 2003, Pretenthaler & Steininger 1999), innovative models of approach to car sharing have been introduced and they have proven to create positive impact in reducing car ownership, traffic, and as well influence the travel behavior of users (Loose et al. 2006). Mobility, for instance, one of the largest car sharing organizations worldwide, had introduced great incentives for users by cooperating with public transport in Zurich. Season-ticket holders could become dual customers of public transport and car sharing while paying a small surcharge (Loose et al. 2006). Additionally, the creation of alliance with Migros, Switzerland’s largest retailer brought huge success for Mobility, whereby a discount program was offered allowing customers to collect bonus points for every time they used car sharing (Loose et al. 2006). In Germany, much focus has been put on combining public transport with car sharing as an integrated service, and the promotion of the concept to a wide audience by using brand names of public transport (Huwer 2004, Loose et al. 2006). Car2Go in Germany, for instance, had a breakthrough with advanced technology integration in the service operations and flexibility offering (Firnkorn & Müller 2011, Shaheen et al. 2009). And recently, in France, the adoption of the concept and customer acceptance has widely increased with the introduction of Autolib—an electric car-sharing program offering customers great flexibility in terms of use. In Italy, new incentive programs have been created to increase the use of electric car sharing e.g. Green Move, which focuses on advanced technology solutions for managing, operating, but also increasing user rates effectively (Luè et al. 2012). In North America, the concept has been broadly commercialized allowing the emergence of many car-sharing organizations that concentrate on various user groups and provide different models of such service. For instance, the neighborhood model has been one of the widely commercialized and dominant in North American car sharing but also throughout Europe (Shaheen et al. 2009). Nevertheless more innovative service models are being initiated such as corporate model targeting businesses, universities, and colleges; residential community model focusing on relationships with members of a community; city fleet model offering service to government and municipal employees during workday; low income car sharing targeting households and neighborhoods with lower income, among others (Shaheen et al. 2009). For example, Flexcar a car sharing program in US focused on commuters and employers (Shaheen et al. 2004) and Zipcar is focusing on university staff and students, and corporates across US recently (Martin & Shaheen 2011).

In a large scale, studies have investigated and analyzed the car sharing concept in our society, economy, and the environment (Boyaci et al. 2013; Bruglieri et al. 2014; Fellows & Pitfield 2000; Firnkorn & Müller 2011; Fougères et al. 2012; Huwer 2004; Katzov 2003; Loose et al. 2006; Shaheen et al. 2007).
2006; Luè et al. 2012; Martin & Shaheen 2011; Musso et al. 2012; Shaheen et al. 2004; Ostermann et al. 2014). Research studies point mainly at the various social, economic, and environmental benefits and impacts of car sharing, as an alternative mobility solution (Luca and Pace 2015). Firnkorn and Müller (2011) discuss the environmental effect of car sharing through a free-floating system in Ulm, Germany. An environmental impact forecast of Car2Go, as one of the first car sharing system with free floating service model, is done suggesting CO$_2$ reduction per average Car2Go-user (ibid.). Additionally, their results indicate an impact on private vehicle ownership if such system is offered permanently (ibid.). Similarly, Fellows and Pitfield (2000) determine the net benefits of car sharing through cost-benefit analysis, whereby even with the most conservative estimates of car-share participation in United Kingdom, net benefits are comparable to road construction. On the other hand, Fougères et al. (2012) take upon a significant approach to analyze car sharing as a social service. Their attempt is to define and provide a push service to car sharing to allow instant processing of an offer or need for transportation that leads intelligent use (ibid.). Yoon (2014) alternatively, shows an extensive study of the economics of car sharing adoption in various large-scale cities. He particularly investigates more technical terms of car sharing models where he studies car-sharing feasibility, electric car sharing fleet optimization, and the efficient fleet management for the city of Beijing (ibid.). Based on revealed-and stated-preference choice experiments, Yoon (2014) concludes that several factors are significant when choosing car sharing. Cost gap; for example, showed to be one of the most important factors which affects the interest for both one-way trips and round-trips if it increases (Yoon 2014). Similar results are shown in a study by Boyacı et al. (2013) indicating that cost of using such system and the level of service offered affects the choice of the user.

Effective management of car sharing service proves to be a challenge in spite of various approaches undertaken by many car-sharing organizations worldwide. Under the innovative spectrum, there remains yet a lot to research in terms of designing car sharing into a desirable alternative to car ownership so as profits are yielded, system is well managed, and yet user acceptance and adoption rates are driven. Particularly electric car sharing service models depict complexity in terms of providing availability of a car to a user at any time they need it and the same flexibility that one is given when owning a private car. For instance, Luè et al. (2012) focus on the efficiency in terms of flexibility of car sharing management models to cater to wide needs for future mobility. Their study intended to give insights on the methods used for designing a car sharing service model. Various characteristics were developed in order to make such systems more flexible for the end user but also for the management of car sharing services (Luè et al. 2012). One key component for testing during the study was the integration of effective technology to connect users, vehicles, and control centers for car sharing (ibid.). Attempting to design a service while considering a wide range of options, they propose, can be effective as such methodology allows modeling a service that will fit to the needs of potential users (ibid.). In this manner, there are also high chances that potential failure points throughout a service provision can be eliminated (ibid.). In another study of car sharing service in Rome, the ability to expand the concept to various city districts is explored (Musso et al. 2012). The service model used there is a simple service with no one-way options, advanced ITS$^1$ for booking or instant access, but which proves to have a great acceptance rate (Musso et al. 2012). Considering the high motorization rates in Rome (978 for every 1000 inhabitants in 2009), it can be assumed that many people are keen to accept such form of mobility, of which price rates are low, no parking fees, free travel in taxi/bus lanes, etc. as Musso et al. (2012) assert. Nevertheless, even for the expansion of such a basic

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$^1$ Information Technology System
service model, an important aspect is worth investigating—the built environment around car sharing locations, according to this study, but also from other studies (Boyah et al. 2013; Shaheen 2009; Yoon 2014). The “service performance is highly affected by the quality of the car sharing parking areas’ built environment”, whereby users’ preferences are linked with the opportunity to walk before or after using car sharing service (Musso et al. 2012, p.3483). A reason for this are the outdoor activities and urban functions that support walking options, thus indicating that the quality of the built environment which encourages walking does affect the operations of a car sharing service (Musso et al. 2012).

Nevertheless, despite various incentives to perfect the service models in the car sharing market, the expansion process in terms of customer take-up levels indicates another picture. Loose et al. (2006) explores car sharing from the perspective of customer demand in large cities where they analyze the customer take-up in Germany. Although car sharing has been increasing recently in Germany, only 0.16% of driving license holders is reported as members of a car sharing organization (Loose et al. 2006). This trend implies that contrary to the innovativeness of this mobility mode, little has been done to upscale this industry by promoting its benefits for society and the environment as well to a wide public. Loose et al. (2006) therefore, focus in assessing various methods to increase the promotion of car sharing services. Their survey particularly intended to first assess the awareness of the population about car sharing, the potential clientele and the acceptance rate by the customers for such mobility alternative (ibid.). More than 50% of the respondents were not familiar with the term ‘car sharing’, though, awareness is higher among those with higher education and personal income (ibid.). Considering Germany’s leading number of car sharing organizations, the low levels of customer acceptance suggest a shift to focus on the users’ and understanding their needs and demands for such mobility. In Sweden as well, analysis suggests that customer up-take is a bit slow and this is due to public awareness of existing alternatives as well (Loose 2010; Schillander 2014). A substantial focus nevertheless in the car sharing market recently is the advanced technology incorporation (Shaheen & Cohen 2007), to increase the use and efficiency of service operations but also improve the interaction of users with the service and the attractiveness of the concept. Car2Go, for instance, integrates various ITC for one-way car sharing system providing also easy user application for bookings and monitoring car availability in real time among other features (Shaheen et al. 2009). Another new approach has been shown by Autolib as mentioned before, which has created an intelligent service built on Microsoft technologies for the Internet of Things (IoT) (Microsoft, 2014b). “By connecting hundreds of handheld devices, more than 4,300 charging stations, 850 registration kiosks and 2,300 cars, Autolib is harnessing streams of data, gaining insights that allow it to better predict customer behavior, optimize car utilization and attract new members” (Microsoft 2014a). These approaches are all intended at up-scaling the car sharing as an alternative mobility that benefits not only the service providers, but also increases the flexibility offered to the user, thus indirectly making such service a more convenient and sustainable choice for mobility.

2.2. Service Models, Design, and Requirements

There have been various approaches to design and create service models for electric car sharing and for various users (Luè et al. 2012). This part discusses some of the service models and major service components required for the design of electric car sharing service. For the purpose of LEV-pool project, the main analysis is on car sharing service models integrating electric vehicles and those focusing on commuters, workplace and residential areas, one way or two-way.
The process of designing an electric car sharing service implies complexity (Bruglieri et al. 2014) since it comprises of different components, which are highly dependent on each other. For example, electric cars have a distance limit after which they ought to be recharged, whereas customers may need a car at any time. Depending on the service model and local approach, different service requirements are necessary to be analyzed when designing such service. As mentioned before, there exist many service and business models for car sharing in general. Service models worldwide range from two way, one way; free floating or non-floating; station based or fixed location; with reservations in advance or booking system based on availability of cars, or real time booking; short term or longer term of use, and different technology. These service models are designed for different user groups as well, briefly mentioned, ranging from individuals from residential neighborhoods and planned communities, corporates’ employees and businesses, commuters and public transport users, students and university staff, and in general all drivers. Almost all electric car sharing service providers cover insurance, maintenance, parking and charging costs, which make a better deal for people who cannot afford to buy a car otherwise (The Economist 2013). However, the spread of electric car sharing concept is currently limited (Luè et al. 2012). “Interesting models are vehicles-sharing services based on the use of a vehicle among defined user-cluster (a model close to household-sharing)” (Luè et al. 2012, p.2981). For instance, one of the most widely adopted models worldwide is the neighborhood residential with the highest market share, followed by business (Shaheen & Cohen, 2007). In Sweden, though, the business shares a larger segment than the neighborhood model (Shaheen & Cohen, 2007). In the neighborhood model, vehicles are deployed in several near-residents’ locations to provide easy access for members, though usually vehicles are accessed and returned at the same lot (Shaheen et al. 2004).

Generally, all electric car sharing service models are comprised of a fleet (size optimization, management, and operations), charging infrastructure and parking locations, booking and payment system, use rates and pricing schemes. Shaheen and Cohen (2007) point out key factors that characterize car sharing operations worldwide such as member-to-vehicle ratios, market segments, parking approaches, insurance, technology, and vehicles and fuels (in the case of electric vehicles, charging infrastructure). These are the conditional service requirements to set up and run a car sharing service with electric vehicles. Nevertheless, car sharing service using electric vehicles poses many operational barriers that often limit the service but also scales up the costs i.e. limited vehicle range, fewer charging stations, or member inexperience as pointed out in an international survey conducted by Shaheen and Cohen (2007). Unlike car sharing systems with conventional vehicles, car-sharing services offered with electric vehicles differ in many aspects. Electric vehicles have different purchase price, maintenance costs, fuel efficiency, fuel price and the range between refueling, and the resultant system design and economics differs greatly (Yoon 2014, p.40). Thus, the design of the service for a fully functional yet attractive model for the users is a complex task involving several components for analysis.

Table 1. 39 parameters that can describe the peculiarities of each car sharing service identified by Luè et al. (2012, p.2981)
In the Table 1 above, Luè et al. (2012, p.2981) compile reviews from the best practices of electric car sharing service models, whereby 39 parameters are shown to describe the specifics of each service. These parameters were used in the service design for Green Move, in the city of Milano, an electric car sharing service with some innovative characteristics i.e. multi-ownership “allowing single users, private companies, and associations to join the
service both using vehicles provided by the service itself and sharing their personal electric car or fleet (a peer to peer approach with electric vehicles)” and ‘Green e-Box’ being the technological bridge that connects users, vehicles, and control center which allows accessing cars with smartphones (Luè et al. 2012, p.2978). The aim of the project was to design a flexible and easily accessible service with electric vehicles open to different types of users (Luè et al. 2012). These parameters may serve as key system specifications for the design of car sharing service, which can be considered systematically.

Putting the overall electric car sharing service design into context, while partly referring to the parameters identified by Luè et al. (2012), it’s essential to determine the vehicles, fleet size, and area of operation as fundamental requirement for the service to be offered. Yoon (2014) has conducted an extensive study in the fleet optimization for electric vehicles based on demand for various service models. When it comes to fleet optimization for electric car sharing, charging time is a key factor. Electric cars need to be charged depending on the mileage they can afford, thus, recharging time shall be balanced with the customer demand in order to effectively satisfy the users’ need in time (Yoon 2014). Fast charging stations can afford a smaller fleet size to satisfy demand, whereas, slower charging station should have larger fleet, Yoon (2014) concluded. Infrastructure costs, which vary based on the charger speed can create potential barrier to developing sound electric car sharing systems (Yoon 2014). Similarly, Boyacı et al. (2013) analyze the electric car sharing in terms of planning requirements for running the service effectively. They allege that the attractiveness of electric car sharing systems is highly dependent on the level of service offered indicated by the accessibility of vehicle stations by the potential users and availability of vehicles (Boyacı et al. 2013). Simultaneously, station number and size, fleet size and availability of cars at the right time and location affect the costs for the service provision (Boyacı et al. 2013).

Providing availability of vehicles at all times for the customers is a challenge for many car-sharing systems. Particularly for one-way operations, the issue is more prominent when combined with unbalanced demand at the origin of the trip but also at the destination (Boyacı et al. 2013, Bruglieri et al. 2014). These situations may result in vehicle accumulation at the not needed stations (ibid.)

The flexibility with which an electric car sharing service operates is another service specific that affects the overall system. Among various service models of car sharing, one way electric car sharing service is shown to be an attractive model for the enhanced flexibility offered to the user (Boyacı et al. 2013; Bruglieri 2014; Schaefers 2013; Shaheen et al. 2004, 2007, 2009) implying a more attractive choice as well. “Traditional car-sharing systems are based on fixed stations, whereas a free-floating set-up allows users to start and end a vehicle hire at any point within a specified area, which therefore enables discretionary one-way usage” (Firnkorn & Müller 2011, p.1519). Autolib and Car2Go use such approach among others. Though, one way and free floating or non-floating types of service differ in terms of parking restrictions (Boyacı et al. 2013). Free floating implies no parking restrictions, where the user can drop off the vehicle anywhere. Whereas non-floating indicates that the pick-up and drop-off locations should occur in designated parking spots. A characteristic of non-floating system, however, is that it allows users to both make reservation and also flexibility for one way trips, which is not the case for free floating as prior reservations are not able (Boyacı et al. 2013). One-way systems allow users to rent based on real-time availability or with short-term reservations i.e. 30 minutes in advance (ibid.).

Nevertheless, the simplification of service model so as to enhance easiness of use and make the service convenient for the user is an important aspect for the electric car sharing system. Luè et al. (2012) mentions ease of reservation, use, and payment as significant components
affecting the success of electric car sharing service. Shaheen et al. (2004) in a pilot program and study of a commuter car sharing model\(^2\) highlight the reservation system to be an important aspect for yielding user satisfaction. The time consuming and complicated procedures of making a reservation/booking were shown to affect the users’ perception of the service (ibid.). Nowadays, most car sharing service providers offer reservations/bookings via mobile apps or online e.g. Autolib, Car2Go, UberGo, Hertz, among many. Nevertheless, many require prior registration, membership, or other information, which is a service prerequisite to access a car as well. On the other hand, easiness of using the service is also a fundamental aspect that requires consideration when designing such service. Service and vehicle access particularly have been addressed in many studies (Boyacı et al. 2013; Bruglieri et al. 2014; Firnkorn & Müller 2011; Luè et al. 2012; Shaheen et al. 2004; Yoon 2014). Most car sharing services use smartphone technologies to offer users flexibility in terms of service access. As for vehicle access, different approaches exist varying from user smartphone serving as a key to unlock the car (Green Move), pin codes and smart cards (Autolib), to chips with RFID (radio frequency identification) inserted on driving license (Autolib, Car2Go).

Notably, technology is changing the way car-sharing services operate and how users interact with such systems (Shaheen & Cohen 2007). Particularly in electric car sharing systems, the efficiency of managing and flexibility of use is rising with the integration of advanced technology use in both software and hardware. Recently, many operators are shifting to automated systems i.e. automated reservations, integrated billing, and advanced vehicle-access technologies, to increase the easiness of use for customers (Shaheen & Cohen 2007). The ICT functionalities are becoming a key benefit from the service contributing to added value proposition, Weiller (2012) states in a case study of Autobil’s business model. This is also highlighted by Ostermann et al. (2014), Schröder et al. (2014), Lu et al. (2013), Luè et al. (2012) among others. For instance, Car2Go has an open-ended one-way system thanks to major technology integration in their system i.e. GIS\(^3\) to locate cars effectively in real-time (Car2Go 2015). In addition, payment for using the service and pricing schemes affect the usage of car sharing service. In many cases payment is usually done on a pay-as-you-go system based on time and miles traveled (Shaheen et al. 2004). Users can also become members, whereby payment can be made for longer periods i.e. one month membership, six months membership, or a year membership following various pricing strategies benefiting members depending on the providers’ approach (Autolib 2015).

### 2.3. Challenges for Electric Car Sharing Services

In this section, electric car sharing and car sharing in general have been examined in terms of service aspects that pose challenges and risks of service ‘failure’ for the providers to cater to wide user needs but also attract more people to use it. More than 25 empirical studies of car sharing with different approaches to service models and vehicle use have been analyzed. The literature was searched based on keywords and selected based on the relevance to the LEV-pool project. For the interest of this study, a particular focus has been put on car sharing service models deploying electric vehicles (EVs). Table 2 below presents in a systematic manner the areas in which there are associated challenges or ‘risks’ regarding the service provision. The vertical axis shows the aspect considered and the horizontal axis shows the type of challenge, and the study from which it has been reviewed.

\(^2\) Commuter car sharing model provides users vehicle access at home and work, as well as a transit linkage on either end of a commute (Shaheen et al. 2004). The aim of this project was to connect short-term rental vehicles to transit and employment centers. The pilot program was named CarLink, which after the test phase, joined with Flexcar in US and got commercialized (ibid.).

\(^3\) Geographic Information System
Table 2. Empirical studies compilation of major challenges associated with electric car sharing service design
## Empirical Studies Compilation of Major Challenges Associated with EV Car Sharing/Pooling Service Design

<table>
<thead>
<tr>
<th>EVALUATION</th>
<th>RISKS/CHALLENGES</th>
<th>EMPIRICAL STUDIES</th>
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<tbody>
<tr>
<td>General</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Profitability in the long run even if membership increases</td>
<td>Luca &amp; Pace 2015</td>
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<tr>
<td></td>
<td>Reaching a critical mass of users to guarantee economic balance</td>
<td>Lue et al. 2012, Fougeres et al. 2012</td>
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<td></td>
<td>Huge sunk costs</td>
<td>Yoon 2014, Shaheen et al. 2004</td>
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<td></td>
<td>Insurance, maintenance, and parking costs</td>
<td>Shaheen &amp; Cohen 2007</td>
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<td></td>
<td>Customer take-up (acceptance and adoption)</td>
<td>Schaefers 2013, Katzev 2003, Loose et al. 2006, Huwer 2004</td>
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<tr>
<td></td>
<td>Awareness of the existing service</td>
<td>Huwer 2004, Loose et al. 2006</td>
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<tr>
<td></td>
<td>Strategic management and marketing</td>
<td>Loose et al. 2006</td>
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<tr>
<td></td>
<td>Knowledge on user behavior</td>
<td>Habib et al. 2012</td>
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<td></td>
<td>Political &amp; legal framework on car sharing (Support policies)</td>
<td>Loose et al. 2006</td>
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<td></td>
<td>Socio-economic and activity based attributes</td>
<td>Luca &amp; Pace 2015</td>
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<td></td>
<td>The uprising sudden demand</td>
<td>Yoon 2014</td>
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<td></td>
<td>Traffic congestion increasing costs for the customers</td>
<td>Autolib 2015</td>
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<tr>
<td></td>
<td>Vehicle comfort, access, and use</td>
<td>Schroder et al. 2014, Schaefers 2013, Shaheen et al. 2004</td>
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<tr>
<td></td>
<td>Easiness of reservation/booking, use, and payment</td>
<td>Shaheen et al. 2004</td>
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<tr>
<td></td>
<td>Access time to vehicles and charging station</td>
<td>Luca &amp; Pace 2015, Katzev 2003</td>
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<tr>
<td></td>
<td>Inefficiency due to management set up</td>
<td>Boyaci et al. 2013, Huwer 2004</td>
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<tr>
<td></td>
<td>The quality of CS parking areas' built environment/ Location set up</td>
<td>Musso et al. 2012</td>
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<td></td>
<td>Concept recognition</td>
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<table>
<thead>
<tr>
<th>EVALUATION</th>
<th>RISKS/CHALLENGES</th>
<th>EMPIRICAL STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users</td>
<td>Time constraint for planning/ Value of Time (VoT)</td>
<td>Loose et al. 2006</td>
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<tr>
<td></td>
<td>Membership requirements and procedures</td>
<td>Luca and Pace 2015</td>
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<td></td>
<td>Maintenance and cleanliness</td>
<td>Shaheen et al. 2004</td>
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<td></td>
<td>Economic incentives</td>
<td>Shaheen et al. 2004, Lewis &amp; Simmons 2012</td>
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<tr>
<td></td>
<td>Residential land use patterns*</td>
<td>Yoon 2014, Shaheen et al. 2004</td>
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<td></td>
<td>Demographics (age, gender, income, education)</td>
<td>Van Acker et al. 2014</td>
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<td></td>
<td>Inability to affect/change behavior</td>
<td>Luca &amp; Pace 2015, Habib et al. 2012, Huwer 2004</td>
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<td>Luca &amp; Pace 2015, Huwer 2004</td>
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<tr>
<td>User Behavior</td>
<td>Inability to affect mode choice for existing journey</td>
<td>Huwer 2004</td>
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<tr>
<td></td>
<td>Being discouraged to use the service over a long time</td>
<td>Katzev 2003</td>
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<tr>
<td></td>
<td>Inactivity of users/members</td>
<td>Habib et al. 2012, Katzev 2003</td>
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<td></td>
<td>Purpose of use/ Perception of CS</td>
<td>Loose et al. 2006, Huwer 2004</td>
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<td></td>
<td>Level of incentives</td>
<td>Loose et al. 2006</td>
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<tr>
<td>User Resistance</td>
<td>Price structure and entrance barriers</td>
<td>Huwer 2004</td>
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<tr>
<td></td>
<td>Financial constraints (level of income)</td>
<td>Katzev 2003</td>
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<tr>
<td></td>
<td>Time</td>
<td>Schaefers 2013</td>
</tr>
<tr>
<td></td>
<td>Lifestyle decisions (events, occurrences, habits and travel attitudes)*</td>
<td>Van Acker et al. 2014, Katzev 2003</td>
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</table>
2.4. Users’ Needs
Electric car sharing is expected to fill a mobility gap for the people. It offers a means to satisfy mobility needs by reducing the necessity to own a personal vehicle, thus encouraging sustainable travel behavior (Costain et al. 2012). This indicates that car sharing tackles the latent needs of the users by offering an alternative to mobility needs. Users have a need for mobility whenever they want to go to another destination from where they are i.e. to work school, leisure and activities, or shopping (Milard-Ball et al. 2005). The means by which they satisfy these needs depend on many external factors among which time and destination distance are crucial. Metz (2011, p.7) notes two important aspects pertaining to most societies—“the need for mobility to gain access to activities beyond the home and the constraints of the 24 hour day within which all activities have to be fitted.” Car sharing, in this dimension then, can substitute the need for a means to move or travel i.e. private car since it offers almost similar flexibility in terms of time spent to reach a destination. Rather than trying to determine the needs for mobility of individuals, which cannot be analyzed in the scope of this thesis, understanding the needs that derive from using car sharing is of higher interest for a project such as LEV-pool. In such regard, it is necessary to look at the users of car sharing (prospective and current), their behavior toward satisfying a need, reasons and motives (including attitudes and experiences) for becoming a car sharer to understand what needs emerge when using car sharing. Additionally, user expectations or demands for car sharing play a crucial role in designing services that meet users’ needs. For car sharing service to work and succeed, emphasis shall be given to the (prospective) user and in what way possibly such service could fill a need, thus becoming a more attractive choice for mobility. Arguably, we can stipulate that by focusing on the users, the service will yield better performance, as service design approach suggests.

Recent studies have focused in examining the users of car sharing organizations worldwide in different aspects. Emphasis has been put in understanding the users’ mobility behavior and attitudes toward various transport modes (Costain et al. 2012; Efthymiou 2013; Habib et al. 2012; Kearney & De Young 1996; Koch 2001; Luca & Pace 2015; Meijkamp & Theunissen 1992; Nobis 2006; Pretenthaler & Steininger 1999; Schaefers 2013; Shaheen 2004; Shaheen et al. 2004; Van Acker et al. 2014). These studies draw upon diverse experiences in different cities and contexts, with different social and economic characteristics, but also various local approaches to car sharing some of which are presented throughout this thesis. “The chances of CSOs are not only connected with general user characteristics but also with the peculiarities of each local car sharing offer” (Koch 2011, p.2).

2.5. User Groups
Depending on the approaches of car sharing organizations, there exist various user groups for which car sharing can be of particular interest. In a study report of users’ needs across different countries, including Sweden (city: Stockholm) by the European Commissions’ MOSES Project (Mobility Services for Urban Sustainability), car-sharing user groups are identified (Koch 2001, p.6).

Table 3. User groups for car sharing along a time axis (Koch 2001, p.6)

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4 Car Sharing Organizations
In Table 3 above, different user groups are shown. For the purpose of this study, three user groups are of particular interest to understand: the early adopters, current users, and prospective users. Koch mentions that the early adopters of car sharing in Switzerland for example, were those tied to the organization itself, whereby through a multiplier effect, the services begun to reach others outside the car sharing organization (2001). Katzev (2003), in a study of the first car sharing organization in US, found that the early adopters were persons who had occasional need for a vehicle and those who expected to make financial savings by becoming a member. Financial savings are also highlighted by an early study from Steininger (1996), followed by the environmental benefit as a second major consideration by Schaefer’s (2013). Attributes linked to the environmental concerns and benefits have been investigated in many studies as key factors for the early adoption of the car-sharing concept, although not always the primary (Efthymiou 2013; Huwer 2004; Katzev 2003).

Most car-sharing operators’ current users are private persons and businesses (Koch 2001; Millard-Ball et al. 2006). Koch notes the affordability of car use and people who do not drive too much, which highlights specific user groups of private persons. Those have distinct social, travel, spatial and attitude characteristics (Koch 2001). He categorizes these groups as low to average income, carless, low travel mileage with high use of public transport, bicycle and walking, who face parking problems, and are discontent with car use (Koch 2001, p.7). Nevertheless, major research in Europe and US, points out to persons with higher education, average to moderately high income, young-middle age, and fairly and not high gender distinctions (dependent on region where car sharing is set up), to be the major user groups in terms of private persons (Shaheen 2004). Though, this also depends on the target approach of the car sharing organization and place. For instance, in Stockholm, car-sharing schemes see high-income households as primary user group (Koch 2001).

In terms of prospective users, the potential for electric car sharing is high since basically everyone having a driving license can use the service but which depends on the context where a car sharing is set. Koch (2001), Huwer (2004), Shaheen et al. (2004) among others have pointed out at the car sharing promotion as key to raising market potential. Nobis (2006) for example, found out from results of a household survey (n=1000) in Germany that the majority of people were not aware of the concept and existing service. Of course, there are distinctions between regions and context, however, studies point at people who drive less, who are more open minded to try new innovations (these come from higher education, high income group) as potential (Koch 2001, p.9). Koch (2001) provides a summary of prospective users’ characteristics that pertain to any car-sharing scheme. The prospective users of any car sharing, he alleges, face certain situations, have distinct attitudes and experiences, and backgrounds as well. He summarizes these as follows:

“More than the average population prospective customers are likely to
• encounter a lesser need for car usage
• face problems with car usage
• think about alternatives likely for a long time and take CS into account
• face some kind of change in their lives, i.e. a move or a separation
• be very aware of car usage costs
• be open minded towards innovations and ready to face some unusual transaction costs
• trust other people and be ecologically concerned”

(Koch 2001, p.16)

More analysis follows in the next sections.

2.6. Users’ Behavior
Changing long-term travel behavior and particularly single occupancy vehicle use (one driver per vehicle) is challenging (Shaheen et al. 2004). “Individuals are reluctant to try unfamiliar ideas, new technologies, or both. Understanding how to change long-held travel patterns is one of the greatest challenges faced by transportation professionals” (Shaheen et al. 2004, p.20). Some researchers have substantially elaborated on the user behaviors with regards to car sharing (Habib et al. 2012, Nobis 2006, Prettenthaler & Steininger 1999, Shaheen et al. 2004a, Shaheen 2004b). Research has shown that car sharing does affect the users’ behavior in terms of reducing driving mileage and car ownership (Martin & Shaheen 2011).

Nonetheless, the focus here is not merely about the car sharing impact on user behavior, rather the user’s behavior in terms of mobility/travel before and during car sharing usage. Analyzing these aspects provides a better overview of the considerations that ought to be taken when designing a user-centered car sharing service.

Habib et al. (2012) investigates the users’ behavior by looking at the enrollment behavior and user activity within car sharing program. Using data from the first North American car sharing program ‘Communauto Inc’ through a dynamic joint econometric model, the study reveals that initially members have short term intentions for membership and membership duration does not imply higher frequency of usage (ibid.). Similarly, Costain et al. (2012) analyze multiple aspects of users’ behavior such as attitude towards environment, safety, usage frequency, membership longevity, vehicle type choice and monthly demand through administrative datasets from AutoShare, a major program in Toronto. Their findings suggest that users prefer to use car sharing during off-peak travel when public transport performance is considered low (ibid.). Easiness of access to car sharing does also affect choice behavior of users (ibid.). Luca and Pace (2015) investigate and model mode choice behavior affected by car sharing to understand the main determinants of pro-choice for electric car sharing in an inter-urban setting in Italy. Results show that users would choose car sharing as a substitute for private car and as a complementary option to public transport (ibid.). Here, access time and parking location were shown to be crucial service attributes to be considered in the design of car sharing systems as predominantly they affect the switching behavior to new alternatives (Luca & Pace 2015). Schaefers (2013) on the other hand, explores the usage behavior of car sharing while investigating the motivational patterns in terms of non-observable variables i.e. personality traits, attitudes, or motives underlying the use of car sharing. The data is derived from a free-floating car sharing service users using qualitative means-end chain analysis. Based on a hierarchy value map created, saving time is perceived

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5 Luca and Pace (2015) find out from their models that car sharers’ behavior is similar to car users’ behavior in terms of access time and monetary value. These are both related to the attribute of parking location for both users, which shows to be of significant value since both users interpret access time as a monetary cost but also value of time.
as a high value affecting the behavior to use car sharing (Schaefers 2013, p.72). Users do value, according to Schaefers (2013), the time saved while using car sharing for they relate to small vehicle size, which makes it easier to find parking spot. This implies that car sharing service configuration ought to consider psychological evaluation of customers for a certain service offer and how they perceive an offer to fulfill their goal. Nobis (2006) as well elaborates on the behavioral aspects of car sharing users, whereby more subjective factors are determined in the context of German population. She finds out that people with multimodal mobility behavior tend to be more receptive to shared-use vehicle systems rather than those who are more appreciative toward personal car ownership (Nobis 2006, p.9). Indeed, mobility behavior has been studied thoroughly for public transport systems and other modes of transport. Studies imply that changing long-term mobility behavior is difficult as people tend to get used to daily travel routines and that they do not always think of alternative choices on a daily basis (Koch 2001). Particularly car-oriented mobility routine constitutes complex underlying psychological attributes that cannot be covered in the scope of this study. For many, car ownership represents freedom and independence and people do like to drive (Nobis 2006, p.8). Subsequently, it is those traits related to owning a car that in many stances hinder the intentions to switch behavior to other modes despite being complementary to a private car.

2.7. Attitudes and Motives for becoming a Car Sharer

Not directly observable attributes of user behavior have often been undermined in literature studies of car sharing as a travel mode. Much attention has been given to quantitative analysis of car sharing usage and car ownership in terms of mobility patterns. As Schaefers (2013) notes, despite the valuable insights derived from econometric studies the influence of non-observable variables on consumer behavior may have been neglected. To understand why people show certain behaviors toward something, simply looking at the end decision does not provide the necessary information. If we look at the mobility patterns of an individual we have to start from the basics – the need for mobility as mentioned previously. The need for mobility is not direct but a process of activities that the individual does which, therefore, create the need for mobility. These include going to work, school, shopping, or leisure, business, and other purposes. To achieve these aims, they fulfill the mobility need by making journeys for the different activities (Koch 2001). To this point, individuals are proposed with alternatives for which they make decisions. From a social theory standpoint, individual actions or decisions are based on motivations from personal wants and goals, or desires, which aim at maximizing utility or reach a purposeful subjective utility (Boudon 2006; Koch 2001; Levin & Milgrom 2004). Freedom of choice over several options comes from ‘rational judgment’, whereby often costs and benefits are weighted. When it comes to mobility, then, individuals make choice over various alternatives of transport modes, assuming that they choose the one that enables them to arrive at the destination point with smallest cost and highest satisfaction as well i.e. on time. However, the motivations toward such decisions significantly affect choice behavior. “Motivation represents a theoretical construct regarded as the basis for all consumer activities, influencing the direction, the persistency, as well as the strength of such activities” (Heckhausen 1977 see Schaefers 2013, p.70). Why people decide to use car sharing instead of other choices is fundamental for service offering. Motivation of individuals for use or purchase is often related to the individuals’ perception or evaluation about an offer to adequately satisfy their need (Rosenberg 1956 see Schaefers 2013, p.70). As well, attitudes and values do comprise the non-observable variables that trigger certain behavior (Schaefers 2013). “Attitudes are one example of such subjective motivations underlying behavioral decisions” (Van Acker, Mokhtarian & Witlox 2014, p.88). “People do what they do because they think that their action will give them a maximum
satisfaction” (Boudon 2006, p.152). Schaefers (2013) from laddering interviews’ data provides major elements of means-end chain analysis\(^6\) which are regarded as the motivational patterns making the basis of car sharing consumers’ behavior. These are depicted in the figure below.

Table 4. Overview of means-end chain elements from laddering interviews’ results (conducted with users of a US car sharing organization) (Schaefers 2013, p.72)

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Functional consequences</th>
<th>Psychosocial consequences</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicles</td>
<td>Easy to find parking spots</td>
<td>Fun</td>
<td>Comfort</td>
</tr>
<tr>
<td>Distinct design</td>
<td>Quick and easy transportation</td>
<td>No worries</td>
<td>Security</td>
</tr>
<tr>
<td>Small size</td>
<td>Access to ownership</td>
<td>No responsibility</td>
<td>Quality of life</td>
</tr>
<tr>
<td>Gas efficiency</td>
<td>Easy to calculate</td>
<td>Not feel stranded</td>
<td>Belonging</td>
</tr>
<tr>
<td>Fleet size</td>
<td>Spend less than for own car</td>
<td>Sense of community</td>
<td>Recognition</td>
</tr>
<tr>
<td>Replacement for own car</td>
<td>Easy identification of vehicles</td>
<td>Something to talk about</td>
<td>Status</td>
</tr>
<tr>
<td>Reasonable prices</td>
<td>Recognize other drivers</td>
<td>Save money</td>
<td>Professionalism</td>
</tr>
<tr>
<td>Everything included</td>
<td>Be recognized by others</td>
<td>Have money for other things</td>
<td>Sustainability</td>
</tr>
<tr>
<td>Pay per use</td>
<td>Reduced CO₂ emissions</td>
<td>Save time</td>
<td>Thriftiness</td>
</tr>
<tr>
<td>Ad-hoc usage</td>
<td>Small distance to next vehicle</td>
<td>Not miss anything</td>
<td></td>
</tr>
<tr>
<td>Free-floating</td>
<td>Less walking</td>
<td>Focus on important parts of life</td>
<td></td>
</tr>
<tr>
<td>Free parking</td>
<td>Availability</td>
<td>Environmental awareness</td>
<td></td>
</tr>
<tr>
<td>Designated parking</td>
<td>Reliability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the analysis of all considerations, Schaefers (2013) identifies four overarching motivational patterns in terms of car sharing usage motives: value seeking, convenience, lifestyle, and sustainability. Value seeking is related to money saving by using car sharing which users refer as reasonable prices and free parking (ibid.). Convenience refers to both vehicle and service related attributes, whereby users link the car sharing usage with the ability to save time and make their life easier i.e. flexible use and easy use of the service (ibid.). The aspect of convenience as a motivation for users has been also highlighted by, Costain et al. (2012), Luca and Pace (2015), Katzev (2003), Koch (2001), Shaheen and Cohen (2007), and Yoon (2014). The third motivational pattern implies that car sharing is seen as a form of lifestyle manifested by a desire of a symbol or status for being a car sharer (Schaefers 2013). It denotes a sense of belonging and community that shares similar values, which car sharing allows to be recognized i.e. labeling of car sharing, vehicle design, and smaller size cars (ibid.). Koch (2001) also points out to this motive in the sense that car sharing will be a social norm similar to car ownership, for specific social groups, whose lifestyles for instance are connected to strong feelings for environmental issues. The last, sustainability, refers to the environmental awareness, which indicates a strong motive for usage (Koch 2001; Schaefers 2013). This is shown both in terms of car sharing characteristics such as electric cars and size, and also in terms of reducing car ownership (ability to go carless). Although a strong motive, in some studies, the environmental attribute, is not the primary reason for usage and users do not often relate their choice with it (Katzev 2003; Koch 2001; Yoon 2014). One other aspect which has been shown as a strong reason for persons to join car sharing is a change in their life, circumstances, or crucial experiences i.e. a new home, a new job, a car damage, etc. (Katzev 2003). Additionally, being discontent with current mobility patterns such as stressing experiences of traffic jams, shortage of parking space, high driving costs, and low performance of public transport may reflect strong reasons to join car sharing (Koch 2001). One other aspect, which has not been explored, however, is

\(^6\) In a MEC framework, four different types of elements are commonly distinguished: a) attributes, b) functional consequences, c) psychosocial consequences and d) values which Schaefers (2013, p.70) refers to a) the distinct characteristics of a car sharing service, such as the fleet size, vehicle and service attributes, or prices, b) qualitative outcomes that are directly related to the service use (e.g., availability), c) psychological and/or social outcomes (e.g. a sense of community), d) centrally held cognitive elements that consumers pursue with their individual behavior)
the experience of the users while interacting with the service to see if such investigation could potentially stimulate usage and frequency of usage.

2.8. Users’ Expectations toward Car Sharing

Mobility alternatives such as car sharing have proven to have many benefits to society and the environment. However, car-sharing industry has not yet reached its full potential as studies suggest. Even if such service is well designed, if users do not see qualities in it, they will not use it. Research has focused in showing the benefits that car sharing offers to the users. Indeed, not much is known toward the users’ expectations of an additional mobility mode being introduced to their life. Users’ point of view does matter in terms of service design for car sharing since they can give insights as to what they desire and want to experience when using the service. Koch’s (2001) study on users’ needs is one of the few analyses in such regard. He identifies some features of car sharing which users see as important qualities of car sharing (ibid.). The data are derived from a survey in Bremen, Germany. Nevertheless, some of the qualities have been also mentioned throughout other studies for other cities as well (Boyacı et al. 2013; Huwer 2004; Katzev 2003; Luca & Pace 2015; Schröder et al. 2014; Schaefer 2013; Shaheen et al. 2004; Yoon 2014).

Table 5. Users’ expectations with regards to car sharing (%) (Koch 2001, p.25)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Customers</th>
<th>Prospective Customers</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>to get a car at the time you want</td>
<td>95.4</td>
<td>93.9</td>
<td>-1.4</td>
</tr>
<tr>
<td>that the booked car is at the station</td>
<td>93.8</td>
<td>97.8</td>
<td>3.9</td>
</tr>
<tr>
<td>to have detailed invoices</td>
<td>90.0</td>
<td>89.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>a departure without delay</td>
<td>90.0</td>
<td>92.7</td>
<td>2.7</td>
</tr>
<tr>
<td>trouble free booking</td>
<td>89.2</td>
<td>87.3</td>
<td>-2.0</td>
</tr>
<tr>
<td>have friendly and helpful administrative staff</td>
<td>83.1</td>
<td>77.7</td>
<td>-5.4</td>
</tr>
<tr>
<td>have a high level of maintenance and safety of the car</td>
<td>82.3</td>
<td>79.0</td>
<td>-3.3</td>
</tr>
<tr>
<td>to have low fares</td>
<td>80.8</td>
<td>90.8</td>
<td>10.0</td>
</tr>
<tr>
<td>to start the car easily</td>
<td>76.2</td>
<td>79.3</td>
<td>3.1</td>
</tr>
<tr>
<td>an easy use of the chip card and the board computer</td>
<td>76.2</td>
<td>75.8</td>
<td>-0.4</td>
</tr>
<tr>
<td>have short distances to Car Sharing stations</td>
<td>73.8</td>
<td>74.5</td>
<td>0.7</td>
</tr>
<tr>
<td>to book cars around the clock</td>
<td>63.8</td>
<td>53.2</td>
<td>-10.7</td>
</tr>
<tr>
<td>to get the car at the place you want</td>
<td>52.3</td>
<td>77.4</td>
<td>25.1</td>
</tr>
<tr>
<td>to have the choice between different car types</td>
<td>40.8</td>
<td>34.7</td>
<td>-6.1</td>
</tr>
</tbody>
</table>

Source: BK+AC survey (Bremen) 1998

From the list (Table 5), the most predominant quality or feature that both users and prospective users value most is shown to be the car availability at the needed time. Additionally, other studies point out to the vehicle access time (parking location of car sharing vehicles), and cost (Yoon 2014) as well. Customers want to have the car available when they need it and be able to access it in a short distance. Despite being a cheaper option compared to owning a car, prospective users particularly expect to have lower fares of use (Koch 2001; Yoon 2014).
3. Method

3.1. Design Theory: User-centered Service Design Approach

The term service design is notably subject to interpretation depending on the context of its use since it is a new field of design. An early description of service design by Gummesson, coined in 1991, defines it as “the concretization of the service concept in drawings, flowcharts...” (see Goldstein et al. 2002). Others have defined the term as one that covers the entire process from idea generation, specification, and service development, to actual testing (see Goldstein et al. 2002). Recently the term has evolved into a design field comprising of various areas concerning the service industry. According to CII7, “Service Design is an emerging field focused on the creation of well thought through experiences using a combination of intangible and tangible mediums. Service design as a practice generally results in the design of systems and processes aimed at providing a holistic service to the user” (see Stickdorn and Schneider 2010, p.30). “Service Design helps innovate (create new) or improve (existing) services to make them more useful, usable, desirable, for clients and efficient as well as effective for organizations” (Moritz, 2005, p.7). FSD defines service design as a “holistic way for a business to gain comprehensive, empathic understanding of customer needs” (see Stickdorn and Schneider 2010, p.32). The emergence of service design as a practice of design approach and theory has taken place in many organizational and management endeavors, providing a whole new spectrum to how service concepts evolve and how they are ‘designed’. As Kimbell (2009) notes, in a contrasting manifesto as how service components have been seen, as arrangements between organizational divisions taking care of different interactions with customers, the service design approach sees all these components and interactions as a holistic picture of an entire service, whereby an intentionally-designed experience of the organization is sought. However, “service design is still in its infancy and there is much to be explored” (Evenson et al. 2010, p.1).

The contribution of design, Evenson et al. (2010) and Moritz (2005) note has been strongly appealing to economic success since 1940s, through central themes of desirability and lately usability and usefulness as crucial aspects of both products and services. Nevertheless, services have not been subject to research, design, and development as products have been (Evenson et al. 2010; Kimbell 2009; Moritz 2005). There is an obvious shift of services from manufacturing to industrialized solutions indicating as well the need for design methodologies and principles (Evenson et al. 2010). In such regards, arguably, the conceptualization of Service Design is of paramount importance when one considers the movement of businesses and society into an experience economy (Evenson et al. 2010). However, “services continue to be an enigma to understand, analyze and model due to their complex nature and lack of definition” (Evenson et al. 2010, p.2).

Services are different from products although they interact with them as in the case of product-service systems i.e. car sharing in this study. They require the presence of a customer for it to be delivered and due to this involvement they become heterogeneous in contrast to the standardized manufactured outputs (Kimbell 2009). Thus, services comprise a complex process of design because every user is different and therefore their experiences of the same service may differ both in time and context (Kraft 2012). Evenson et al. (2010, p.3) view services as performances implying “choreographed interactions manufactured at the point of delivery that form a process and co-produce value, utility, satisfaction, and delight in response to human needs.” The range of service design entails the entire details from the users’ needs, how to satisfy them, what can be done for the user, and how to achieve this (see

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Goldstein et al. 2002). As such, it becomes obvious that the central approach to service design is the users (Goldstein et al. 2002; Kraft 2012; Moritz 2005; Stickdorn & Schneider 2010). Subsequently, the understanding of these users, their goals and motivations, and their needs is of high significance for designing services (Moritz 2005).

Based on the book ‘This is Service Design Thinking’ by Stickdorn and Schneider (2010), there are five key principles of service design thinking. First, service design is user-centered indicating that services should be seen through the eyes of the customers when designing. Second, it is co-creative in which all stakeholders are to be involved in the design process. Third, it is holistic, whereby the big picture is to be considered. Fourth, it is sequential in which the service is to be visualized “as a sequence of interrelated actions” (Stickdorn & Schneider 2010, p.33). And finally, fifth, it is about evidencing which is considering the intangibles in terms of physical artefacts. This implies that in such process, taking upon a holistic approach is a necessary aspect when it comes to designing a service. Looking at the process as a whole means considering people and understanding their needs, their experiences, and expectations while also analyzing the service on its own in terms of context, concept, operation, and as well location where it takes place. In a co-creative manner and iterative process, these are synthesized to visualize the overall view as to what the service should be and what it will do for people.

Though, service design is an iterative complex process that goes through various stages (Stickdorn & Schneider 2010). The possibility, however, is to map a structure of these stages which still is iterative in approach. The integration of different activities throughout the service design process occurs through exploratory, generative, and evaluative research stages from discovery to release of a service innovation (Evenson et al. 2010). This thesis will be using similar structure focusing in the two initial phases of the process – exploration and generation. The intention is to gather insightful knowledge of both users and service requirements resulting from users’ needs before LEV-pool service is tested.

3.2. Service Design Methods

This thesis explores both the users and the service of electric car sharing by taking on a user-centered service design approach. Service design is a practice that deploys numerous methods and methodologies into the process while integrating a variety of other disciplines. As an evolving discipline, there is not yet a set of established theoretical methods that prove to be of holistic practice in various service design processes. The need for set methods for service design approach has been widely recognized among researchers and practitioners in the field (Akama 2009; Evenson et al. 2010; Evenson & Dubberly 2010; Goldstein et al. 2002; Kimbell 2009; Moritz 2005). Though, service design can be considered as an explorative process as well as analytical for it involves many aspects of various disciplines (Holmlid 2007). Many service organizations aim for their own methods for designing services through different practices depending on the design challenge (Evenson & Dubberly 2010). Service design methods address particular features of services by investigating user dimensions that influence them, so-called touchpoints, which users encounter throughout a service use, enabling the compilation of different service and product components (Moritz 2005). “Every encounter of a part of a service is called a Touchpoint” (Moritz 2005, p.31). Touchpoints are the linking pieces of a whole service that are derived based on the overall experience that a customer has while interacting with the service (Moritz 2005). For instance, services are complex experiences which happen over time, are interactive, and spread throughout various touchpoints (Moritz 2005). Evenson et al. (2010) considers these touchpoints as milestones in a person’s experience with the service.
Since service design is user centered, at the explorative stage, it is paramount to incorporate design methods that derive and reveal the touchpoints of users across the service, whereby users’ perspectives pinpoint at what the service should be. Doing so implies using design methods that allow the designers to understand users, their needs, behaviors, and experiences on one hand, but also understand the business, technical and domain requirements and constraints regarding the service itself (Moritz 2005). “This knowledge can be translated into artefacts, into plans for artefacts or strategies that set frameworks or give direction. Design ensures that the overall experience of products, services and spaces is useful, usable and desirable as well as efficient, effective, economically viable and technically feasible” (Moritz 2005, p.35)

Though mapping users’ needs while as well searching beyond the tangible variables and quantitative data on users is a complex task, and often very time consuming. The human needs vary and are individual which can’t be standardized (Kraft 2012; Moritz 2005), thus, understanding and catering to those needs is complex in the design of services particularly. “Depending on context and situation every client has different needs even for the same service” (Moritz 2005). Where clients are directly involved in the process, the mechanics of user behavior, as Kraft (2012), Evenson et al. (2010), and Mortiz (2005) note play a crucial role. Service design, as such, integrates people at all stages of the design process making them co-designers of the service experience (Evenson et al. 2010). “A human-centered service design research approach begins with people: their goals, what they do, what they want to achieve, what they experience” (Evenson et al. 2010). Inarguably, understanding and experiencing the customer journey in a similar way as the user would is of critical importance in the design process of services (Evenson et al. 2010; Evenson & Dubberly 2010; Holmlid 2007; Kaario 2000; Kraft 2012; Moritz 2005; Stickdorn & Schneider 2010)

This thesis integrates three widely practiced methods of service design, which are used to explore and create a holistic view of the intangible user dimensions and service requirements affected by these dimensions. These methods (tools) are Customer Journey Map (sometimes referred as User Experience Map), Personas, and Stakeholders Map which are described and defined below in terms of this master thesis approach. In an iterative process, from the users’ perspective, these tools enable understanding of users, capture and present in a holistic manner their needs, behaviors, and their experiences. Whereas from the service point of view, these methods can reveal important insights such as key service components of high interaction with users, opportunities to better satisfy users’ needs, and problematic areas which may lead to user disappointment among others, while at the same time, revealing strategic insights as what can be done next to improve the service.

3.2.1. Customer Journey Map

Customer journey map is a strategic method that allows capturing and making visible key insights of the interactions across experiences of the user with a product, service, or ecosystem (Adaptive Path, 2013). The map provides a holistic overview of the factors influencing user behavior and experience, thus, allowing for understanding of users’ needs while emphasizing on problematic and opportunistic areas of the service (Stickdorn & Schneider, 2010). Experiences do matter in the service context, Evenson and Dubberly (2010) point out, as our lives are shaped and emerge from the experiences we have. People look for experiences that fulfill their needs and satisfy their wants, and in today’s world the search for more meaningful experiences is rising (see Evenson & Dubbery 2010). “Very often, the success of products, services, webpages, and even companies and brands comes back to one single thing: successful user experience innovation” (Kraft 2012, p.1). ISO standards define experiences as “a person’s perceptions and responses that result from the use
or anticipated use of a product, system or service” (Kraft 2012, p.1). Throughout a service, customers create unique experiences when interacting with a service provider “across different touchpoints, responding to the different designed elements, along with other elements that are not under an organization control, such as the social environment” (Verhoef et al. 2009 see Teixeira et al. 2013, p.364). Understanding those experiences and the behavior of users when interacting with a system are the prerequisites which service designers put upfront to enable the occurrence of desired experience by the user (see Teixeira et al. 2013). Kraft (2012), in his book, provides five key characteristics of a successful user experience innovation: relevance, positive feelings or ‘wow’, perception of uniqueness or novelty, visibility, marketability. To develop these characteristics for the LEV-pool service, it is important to look into the concept and service design from the perspective of users along their journey of using a service. A crucial element here is focusing on users’ needs that can be derived from this process, which Kraft (2012) sees as the cornerstone of all successful user experience innovation.

3.2.2. Personas
Personas are one of the widely used methods in service design to extract or gain insights about users of the service that is being offered. Personas are “a documented set of archetypal people who are involved with a product or service” (Saffer 2010 see Teixeira et al. 2013, p.363). Such method can provide information about the users who will use the service (Teixeira et al. 2013). Particularly, personas allow identifying specific user profiles. An important aspect of this method is to view the product or service from the user’s perspective (Cerejo 2013). These archetypes usually result after a deep observation of the potential users (Cerejo 2013, Bustos 2011). When designing services, using customer insights enables creating various personas (archetypes) and understanding how customers may interact with the service (Parker & Heapy 2006). By creating personas, service providers can capture information as to how the service will be used and perceived to satisfy a need. Evenson et al. (2010) note that the use of personas has become a necessary component in any service design process. Parker and Heapy (2006) acknowledge personas as a method that enables service providers to engage emotionally as well as rationally with their users. They can move the focus toward the real needs and wants of the people, away from the abstract demographics (Stickdorn & Schneider 2010). Developing personas of the potential users of LEV-pool is one of the approaches to this thesis, whereby the intention is to have a better picture of who are the potential users, what are their needs, behaviors, and experiences with regards to car sharing.

3.2.3. Stakeholders Map
When designing services, many people are involved and each play a role in the service provision which affects the way customers interact with it and perceive it. Stakeholders comprise of all the actors involved in the service from staff, customers, partner organizations, etc. (Stickdorn & Schneider 2010). Stakeholder map, in this context, is “a visual or physical representation of the various groups involved with a particular service” (Stickdorn & Schneider 2010, p.150.). Such representation shows the system of actors and their mutual relations depending on where the focus is (Service Design Tools 2015) –in this study the user. Stakeholder maps are a helpful way to understand and highlight the issues that concern each stakeholder group, and particularly users (Stickdorn & Schneider 2010). As such, using such method in service design, allows for more effective use of resources throughout the service, whereby complex situations surrounding the service are visualized (Stickdorn & Schneider 2010). This tool is often used to also build a shared vision of how the service should be and appear to the end user, which is drawn upon the insights gathered from the users. The method reveals as well the interests and motivations of each stakeholder, whilst
enabling identification of areas with potential opportunity and risk in terms of service improvement. In this study, stakeholder maps are used to identify the key challenges concerning all stakeholders, and specifically users in the process of service design for LEV-pool. The LEV-pool project involves numerous actors that each have a key role in the service components, therefore, understanding the roles and relations of each stakeholder is important for revealing opportunities for designing a better service that relates to the users’ needs for mobility.

3.3. Data Collection Methodology

In this study, the primary sources for data collection are workshops. Using the three service design methods, three experimental workshops were conducted in the actual setting of the LEV-pool project while as well combining information from existing user studies in the project’s setting as well, hereby Botkyrka Municipality in the region of Stockholm. The intention was to gain more specific insights, in a qualitative manner, onto the users for whom the project is intended. Conducting workshops instead of interviews or surveys has been shown to be a productive and effective methodology for collecting qualitative data on the intangible and not directly observable variables i.e. needs, behaviors, and experiences of people. Workshops are interactive, more engaging, and enable participants to reveal information that may otherwise not be shown in qualitative or quantitative research such as interviews or surveys (Adaptive Path 2013, Buxton 2007, Moritz 2005).

The secondary source for data collection has been extensive literature compilation and synthesis on car sharing service models worldwide, which have been both scientifically and practically investigated and studied (presented in chapter two). A synthesis of existing literature has been made to determine some of the critical service requirements for any car sharing model, and then focusing on similar service models to LEV-pool concept. In addition, literature about users’ needs, behaviors, motives, and expectations toward such mobility alternative was gathered so as to gain a broader perspective and understanding of car sharing users in terms of dimensions explored throughout this thesis.

3.3.1. Workshop with Researchers

The first workshop was conducted with the researchers and designers involved in the LEV-pool project. In an interactive and collaborative manner, the workshop’s main activity was building the customer journey map of a prospective LEV-pool service user using the customer journey mapping method. The objective was to identify the LEV-pool users’ needs, their behavior toward meeting the need, and their experience in terms of feelings, emotions, and thoughts throughout the journey of using LEV-pool, whereby key service requirements could be derived as well. The map integrated three key building blocks to provide a structure to user dimensions –doing, feeling, and thinking (Adaptive Path, 2013) from which the journey of a user was explored and described. Additionally, in a time-based context different stages of a typical car sharing user were identified as research and planning, booking, pre-travel, travel, and post-travel. The map included as well service touchpoints, channels, and opportunities for the service, which are to be used as service insights (takeaways\(^8\)) derived from the map. The service design method ‘customer journey map’ canvas was adopted from the Adaptive Path’s Guide to Experience Mapping (Adaptive Path 2013) in combination with

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\(^8\) In a customer journey map, “the takeaways summarize key findings from the experience mapping process” (Adaptive Path p16, 2013)
the tool from the book ‘This is Service Design Thinking’ (Stickdorn & Schneider 2010) since these suited better the aims of the workshop. For this process, existing qualitative and quantitative data (see section 3.6.) of the Botkyrka Municipality users was gathered, which was the basis of the mapping process.

When conducting a customer journey map, although an iterative process, there is a basic framework that is used to design the map and interpret data depending on the design challenge. From a compilation of existing customer journey maps, the design agency Adaptive Path defines this framework as the lens (in what context the journey is being analyzed), the customer journey model (the range of interactions users have across channels, touchpoints, time, and space, when trying to satisfy a need) including qualitative insights, and the takeaways (a summary of key findings from the mapping process) (Adaptive Path, 2013). Similar framework has been used for the design and analysis of the customer journey map for this study. The lens, in this map, is the two different personas analyzed depicting two different user groups of LEV-pool with distinctive characteristics. Next, the customer journey model presents visually the highlights of the actions that users take when trying to satisfy their needs. Here, touchpoints are also presented, depicting key service components, which users interact with. In addition, the user qualitative insights are charted throughout the building blocks of the map showing the thoughts, feelings, and needs of the users. At the end, service insights are mapped, which are the process’ takeaways that may be opportunistic, critical, and strategic points for the design of the service. Service insights are depicted in two blocks –the channels and opportunities. The channels are the mediums with which the service reaches out the users and with what users interact when using the service. Whereas the opportunities are different strategies that can be undertaken to target a certain aspect of the service so as to satisfy better the needs of the users, enhance their experience, or even affect their attitudes or behavior.

3.3.2. Workshop with Users
The second workshop was conducted with users at Botkyrka Municipality who are already users of other car sharing. The workshop was designed to get more qualitative insights about these users in terms of their personality, characteristics, behaviors, needs, and experiences with regards to their mobility to and from work, in order for LEV-pool to determine which users may actually use the service. These users were engaged in a creative mapping process, where they could talk about their needs, behaviors, and share their experiences by evaluating
different car sharing services they have used. By combining the travel survey results of Botkyrka Municipality and the results from this workshop, it is possible to gain a better understanding of the real users. Through a mapping activity, the participants were presented with different qualitative questions that had the intention to involve everyone in the discussions. Participants were first asked to write down information about their age, occupation, and place of work and then asked to describe a typical day to/from work onto a paper. It was important to know what kind of work they do since, as noted in the Botkyrka travel survey, some departments have higher mobility needs than others. Throughout discussions, participants were then asked to write key insights on post-it notes about the journey they make to/from work and during working hours, which were collected and placed on a white board map. Similar to the first workshop, the activity aimed at revealing intangible dimensions of the users, which data was used to generate a more accurate overview of the users. The mapping process allowed for evidencing discussions, which data has been used to create a map of personas (user profiles) of prospective users, which depict the dimensions explored.

3.3.3. Workshop with Stakeholders
The third workshop was held inviting all stakeholders of the LEV-pool project with the intention to map the key challenges and issues concerning the service and the opportunities with regards to the gathered information about current and prospective users. Using stakeholder mapping method, the objective was to understand the concerns of the users when using car-sharing and the concerns regarding the service offering itself, while mapping each stakeholder around these issues as the role player. Through a set of qualitative questions for discussion, a mapping process was done whereby a stakeholder map is derived starting from the users as the central aspect influencing the roles of each other stakeholder in the LEV-pool project. The discussion began first by mapping main issues and opportunities of LEV-pool in general. Then, using a stakeholder map template where the user and the service are placed at the center, those issues and opportunities were mapped around each central topic. The aim was to derive a map of concrete issues form both users’ and service perspective for which each stakeholder’s role is identified. An important aspect of this workshop was the presentation of findings from the first two workshops, which allowed the stakeholders to build and reflect upon those data, especially in terms of critical aspects identified.

3.3.4. Project Site and Travel Survey Results
The LEV-pool project will be tested in two sites—a suburban and rural environment. One is Botkyrka Municipality, a suburban region in Stockholm, and the other is IKEA base in Älmhult, a rural town in Southern Sweden. In this study however, the focus is on the Botkyrka Municipality due to availability of data on users and time constraints posed for studying the users at IKEA base. Botkyrka Municipality is actively working to reach their climate goals of being a fossil fuel free region (Botkyrka Kommun, 2015). As such, their aims are to convert to biofuel and electric vehicles. The municipality has good access to rail transport but the bus is not sufficiently attractive, making car the preferred mode choice for commuting to work, leisure, and shopping. In 2014, the Municipality conducted a travel survey Intern Resvaneundersökning (Botkyrka Kommun 2014) among its employees to understand their travel behavior whose results are presented below. These data have been used as preliminary analysis of users during the first workshop of this thesis.

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9The travel survey at Botkyrka Municipality, ‘Intern resvaneundersökning’ (Botkyrka Kommun 2014), report is in Swedish language, and the results have been translated to English for the purpose of this thesis.
With a 50 percent participation rate, the results indicate that nearly 50 percent of the employees take the car to work, 30 percent of them use public transport, and the remainder use bicycles. The mode choice for travelling is partly influenced by distance, age, and occupation. Those who commute by car to work mostly live within 5-10 kilometers from the workplace. In terms of age, those over 40 years use cars to work mostly. The results show that car is preferred as age increases, while public transport is a preferred alternative by the younger employees, <30 years. Travel patterns between genders, however, are of marginal difference. One exception is in terms of the proportion of pedestrians where there are more women than men.

The reasons highlighted by those using the car to work are time saving, comfort, and the possibility to combine commuting to work with other modes. Though, despite this trend, 85 percent of the respondents assert that they can take public transport but only 30 percent of them do actually use it. On the other hand, 80 percent of those who use car regularly to work assert that they can take public transport, and they would be more motivated to use public transport if it would be cheaper. Every third car user indicate that cheaper price of PT would be a motivation. In addition, increasing public transport frequency and reducing waiting time between different modes, would encourage people further to use public transport. Indeed, comparing to 2009, the travel patterns have changed notably. The highest mode choice for travel is shown to be public transport (38 percent, 17 percent higher than in 2009). However, business trips with municipal vehicles have increased 37 percent more. Most of the users of municipal vehicles (from carpool and conventional vehicles) are men over 50 years. An interesting fact is that among those who do not have access to carpooling have shown a high interest (40 percent) to use such mode if it was available, and particularly younger women are more interested. The survey shows that having a carpooling/ car sharing service offered with high frequency of service and a simple payment system would greatly motivate people to use it and combine it with public transport. What affects the decision of employees on the mode choice is mainly the distance from their home to the workplace. Those with a distance between 2-30 kilometers usually prefer car, whereas those with a distance above 30 kilometers use public transport more.
4. Study Results and Analysis

4.1. Workshop I

In the first workshop, there were eight invitations sent to the research team in the LEV-pool project. Six of the members participated in a five hours long session. The team worked with the three generated personas (user profiles) to build the customer journey of a prospective LEV-pool user. These three personas describe the three different user groups identified in the travel survey of Botkyrka Municipality. Those are the prospective users (see appendix: persona 1), early adopters (see appendix: persona 2) and potential users (see appendix: persona 3). An important aspect in this activity was showing empathy by thinking as a user and relating to their behavior in different stages. Due to time constraints, only maps of the two most important user groups were derived – the prospective user which for LEV-pool would be daytime user and early adopter as the morning/evening user (in Swedish: fodervärd) Each of the users have different personalities, needs, and travel behavior and such information was used in the mapping process.

Figure 3. Mapping customer journey activity during the workshop with researchers

The results of the workshop are presented in the map below (Figure 5), where all the information was extracted and put into a computer program for clearer visualization and some of the input was corrected in terms of language formulation to enhance comprehension. The data from the map has undergone a categorization process in an iterative manner in order to show a compelling visual narrative. Herein, key insights from each of the map’s building blocks have been visualized and the full customer journey map is presented. This categorization process enabled the presentation of the workshop data findings into a comprehensive map, which captures and shows in a holistic manner user insights in terms of the LEV-pool service users. For example, presenting the user actions through visual icons rather than text enables better and easy differentiation between users’ activity and behavior.
4.1.1. The Lens
The LEV-pool concept targets two main user groups in terms of the service offering which is the lens of this mapping process. The daytime users are the ones who are able to use the service during their time at work to commute between offices and other places depending on their needs. Whereas, the morning/evening users are the so-called ‘parent’ users because they bring the fleet vehicle to work in the morning and pick it up at the end of the day. They are considered as the parents of the vehicle, which is a characteristic of LEV-pool concept. Additionally, these user groups are the ones to take care of charging the vehicles during the night, but are granted to use the vehicle also during the weekends as per their needs. Considering that these user groups differ in terms of using the service, it was important to map both users’ journey to understand the needs of each group. In this perspective, the map reveals that the journey for each user group differs mainly in the planning and the post-travel stage, which is elaborated further on.

4.1.2. User Journey Highlights
The building block ‘doing’, in the map, reveals insights into the behavior of the users throughout their journey stages in terms of satisfying a mobility need. At this point, the map shows that both user groups go through different activities although in the same journey. Each of the user group, the daytime user and the morning/evening user behaves differently to satisfy a need – in this case, a time based need. For example, for a daytime user, in the research and planning stage (see Figure 5), the actions are undertaken depending on the circumstances such as events at their workplace which shape their activity of how they search and plan the service of car sharing. Their activity process, then, is non-linear, implying that the user may need various planning information about the service through different mediums, at different times, and different places. Whereas for a morning/evening user, the activity at this stage is completely linear since they have to go through similar behavior on a daily basis. This process implies that the needs at the planning stages vary among the users. Similar pattern is shown in the last stage of the journey (see Figure 5), whereby both users behave differently although both go through a linear process in terms of the course of actions. Meanwhile, for other stages in between, the behavior seems to be similar for both user groups since the morning/evening user as well has to go through similar actions if s/he wants to continue using the service even after arriving at work.

The touchpoints in the map show the key user encounters with the service which lead to user experience. For example, in the planning stage, users’ motivation to use the service is a significant encounter on which the success of the service does depend. Providing incentives for becoming a tester/user of LEV-pool was highlighted during the discussions, for which different options were considered so as how to attract new users. Informing the prospective users well in advance and motivating them by showing value of being a user were proposed. Another touchpoint is the interaction with the booking system and how that appears to the end user. Here, simplicity of the booking system shows to be a qualitative aspect for satisfying the prospective users’ expectations. Also, the need for responsive system is highlighted since users need confirmation about their actions. For instance, one of the most critical service touchpoint discussed was also ‘parking for a short time’ in between booking time. From the information gathered on the users, it is noted that daytime users may have such need when using LEV-pool. Considering that the vehicles will operate keyless and the booking time is intended for short periods, this feature may be not possible for the system. This may exclude some users if they perceive it as important for their travel need. On the other hand, if such feature is made possible, then it may disrupt the booking of other users if
the system does not coordinate bookings in real time. Moreover, the usage rate also is another service encounter which requires attention as shown in the map. Since the test phase of the service will be offered for free, there is a risk of overusing the system, meaning booking a vehicle for a longer period than needed. Such behavior might lead to a disruption in the entire system by iterating the purpose of the vehicles into personal cars, thus misaligning the concept of LEV-pool itself – ‘keep the wheels rolling’ (meaning keep a high occupancy rate).

4.1.3. User Qualitative Insights
In the block ‘thinking’ the user’s journey is depicted in terms of the questions and thoughts they have throughout their journey. From the map, it can be easily differentiated that the two users have varying thoughts throughout the stages of their journey. For example, in the planning stage, daytime users are more concerned about accessing the information they need, whereas morning/evening users think more in terms of the vehicle aspects since they feel responsible for it. From the discussions during the workshop, one of the stages was seen as a critical service touchpoint, the travel stage. Here it was noted that any type of user shall be familiar with how to start the engine and drive the vehicle provided by LEV-pool, since the vehicles of the fleet are not entirely similar to ordinary vehicle systems. As noted in the map as well, many questions and thoughts may arise from the users regarding the experience of using the LEV-pool vehicles. This suggests that, at this travel stage, if the user is not being able to understand how the system works, it might lead to a negative experience which may result in dissatisfaction with the service. Therefore, it is important to communicate clearly the information to the user before interacting with the vehicle so that confusion is reduced and a better experience is offered.

In addition, different questions arise by both user groups as they try to move to the next stage of their journey. This section indeed provides practical insights into the users’ thoughts allowing to see the amount of information needed by the user throughout different stages. As shown in the literature study as well, information communication is a significant aspect influencing the use of car sharing service. The simpler usage of the system, the more attractive it becomes for the user to try it. As such, being able to see what kind of information users need throughout their journey may give a good understanding as to what needs to be improved and to be able to provide such information to the user at the needed time. Referring to the map, the data shows that the planning stage and the travel stage require clear information communication but also various channels to communicate such information i.e. mobile phone, in-vehicle screen etc.

In the block ‘feeling’, user’s journey is shown in terms of the emotions felt during each stage along the journey. The data shows mixed emotional patterns through different stages even among the same user. Along the journey, more positive feelings and emotions are revealed at all stages except the travel stage. At this stage, there are mixed feelings experienced by the user which arguably are related to the usage of the vehicle. This might be a factor affecting the emotional state of the user. Though, between the different user groups, the patterns change especially in the planning and post-travel experience among morning/evening users. This group of users may go through different emotional stages after a period of using the service. Since these users are of critical importance for the project, it is important to enhance their experience in the long term by providing support through different incentives as pointed out in the map as well. The feelings of the users throughout their journey using LEV-pool service provide valuable insights for the service design. Knowing the emotional pattern that

10 In the LEV-pool fleet, the vehicles used are Renault Twizy, which is a light weight two-passenger electric vehicle.
each state triggers onto the users may allow for better improving the service experience when users interact with it.

As the central focus of this thesis, users’ needs are also depicted in the customer journey map. The mapping process, as an explorative method, systematically derived the needs of the users along a typical journey they make. Overall, the results show that the (prospective) users have different needs and make use of the service in different ways. For example, the daytime users may be those who use the car very often during their day at work, but there are also users who occasionally need a car. This implies that a flexible service offering is required to meet all those needs. In general, the map highlights the need for:

- fast and easy access of information in the planning stage,
- a simple booking system that is responsive to user actions and travel patterns in the booking stage
- the vehicle parked in close location and real-time information about the availability of the vehicle in the pre-travel phase
- service support at the right time in the pre-travel phase
- instructions and guidance on how to use the service and the vehicle in the travel phase
- motivational feedback in the post-travel phase

Depending on the user group, the needs may vary in terms of time since different needs arise throughout the journey. But overall, looking at these data from the service design perspective, they provide a structured map of the intangible user dimensions and the service components affected by these dimensions where focus shall be given in order to satisfy users. The map, however, does not reveal the general mobility needs of the (prospective) users; rather, it explores the needs in terms of using the service or the needs to use the service of LEV-pool.

### 4.1.4. Service Insights

As a final outcome of the mapping process, service insights are derived from the data analysis of the other building blocks of the map. As seen in the map (see Figure 5), there are a handful of channels that were identified during the mapping process in the workshop, with which LEV-pool service can reach its users. The most common channels throughout the travel journey are seen to be the mobile phone (smartphones), web platform, service support (call center), e-mail, and print media (i.e. vehicle labelling and info spots) as desirable means of communication by the users. Especially the mobile platform, which is the user interface, is shown as necessary throughout the entire journey. This implies that creating a user interface where all information is handled through the mobile platform would be an effective way to address many needs of the users. This channel can be a cost-effective method how to reach customers and manage information in one platform –through smartphone application.

However, this also indicates that the design of the interface shall integrate many features that coordinate in real time and are responsive to user actions i.e. booking confirmation just before the booking time begins.

Meanwhile, in the opportunities section, concrete measures have been suggested during the workshop session. For each journey phase, the building blocks have revealed insights that require attention from the service perspective. Elaborating on these blocks allowed the team during the workshop to map opportunities as to what can be done to enhance the experience of users, eliminate possible negative feelings, and as well satisfy the needs of the users. To highlight some, in the planning stage, for instance, the opportunity to use the KTH label as a credible and trustworthy name was considered as an incentive to attract the users who will first test the service. In the booking phase, on the other hand, more technical aspects are
proposed such as providing a user interface that is responsive to user actions and as well with distinct features to cater to different users’ needs i.e. ability to extend booking if needed. At the pre-travel stage, interactive media i.e. video, among others, was proposed as a way to inform the users on how to use the service and the vehicle particularly. Additionally, a positive attribute proposed is naming vehicles with interesting names for easy identification by the user. On the other hand, in the travel stage, different opportunities were considered as to tackle the issue of ‘unfamiliarity’ with the vehicle and the system. For example, in-vehicle guiding system on ‘how to use’ was proposed or the possibility to have a staff member showcase the functionality and guiding stickers for fast comprehension are some opportunities among others to offer a better first experience to the user.

4.2. Workshop II
Out of 13 invitations sent to the employees of the municipality, seven of them attended the workshop. The workshop results show, in general, heterogeneous users which have different personalities, different needs, different purpose of using car sharing, and different experiences with regards to shared-use systems despite having used the same service.

4.2.1. User Information
The participants in the second workshop were of age between 30 and 60 years old, which implies that we are dealing with users that use mostly the private car to work according to the Botkyrka Municipality survey. They were all at least one time users of car sharing at their workplace. These participants live 4.5 km on average from their workplace which indicates why some take their own car or public transport to work. Each of the participants have different occupations and work in different municipal departments – the majority is based in the municipality’s main building and move in-between offices quite often. When asked to describe a typical day to/from work, each of the participants showed different travel patterns. For instance, five of them use private car to work combined with walking, biking, or public transport depending on their after work activities or season (weather). Six of them stated that they do activities after work, from which two also pick up children at school and that is why they take the car to work. During working time, if they need a car, they mainly use the municipality’s cars if available or carpooling. In many cases they use their own car to meetings due to time constraints or take public transport if they need to go to a more distant place.

These participants have all various needs when it comes to mobility at work, which depend on their job activities. Some have many meetings throughout the week, thus need transport
regularly. Whereas some have only occasional need for transport since most of the time they are at the office. However, there were also those who have immediate need for mobility due to activities happening with short notice.
<table>
<thead>
<tr>
<th>STAGES -&gt;</th>
<th>User</th>
<th>RESEARCH AND PLANNING</th>
<th>BOOKING</th>
<th>PRE-TRAVEL</th>
<th>TRAVEL</th>
<th>POST-TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviors</td>
<td>Planning User/ Regular Needs</td>
<td>Plan in advance (two weeks, one week, or five days before) Check: the personal schedule</td>
<td>Book on webpage through Ipad, phone or computer Check: the personal schedule Book for travel time and meeting time Book half day or whole day Include booking in personal schedule Consider finances in terms of costs of bookings</td>
<td>Check email for registration number of the vehicle and color Copy info in personal agenda Go to parking and identify the car/keep based on registration number Check cleanliness</td>
<td>Start with key/button Drive Sometimes issues with frozen lock</td>
<td>If done early, try to cancel the rest of booking Verify the invoice Park back at the parking lot Put back the key If not available parking space, park somewhere else and report that</td>
</tr>
<tr>
<td>Planning User/ Occasional Needs</td>
<td>Plan in advance (few days before) Check availability of vehicles Book when need arises</td>
<td>Book on webpage through computer Book for travel time and meeting time Book extra for additional activities Book for few hours only</td>
<td>Check the booking email for which car i booked Identify the car in the parking</td>
<td>Start with key/button Drive</td>
<td>Park back at the parking lot Put back the key</td>
<td></td>
</tr>
<tr>
<td>Instant User/ Instant Needs</td>
<td>Need a vehicle now! Check availability right away Go to web or in Outlook If vehicle’s available, book!</td>
<td>Book on webpage through computer Book one hour up to whole day Book as needed and if available</td>
<td>Check email for registration number of the vehicle and color Look for pre-code Write it down on a paper before leaving Find the car</td>
<td>Start with key/button Drive Towards destination</td>
<td>Park back at the parking lot Put back the key</td>
<td></td>
</tr>
<tr>
<td>Experiences</td>
<td>Planning User/ Regular Needs</td>
<td>Feeling guilty when a vehicle is not available at the needed time, but not frustrated</td>
<td>Little space to plan all the activities Feel overloaded sometimes Angry if booking is not used as per booked time Book with margin (to avoid troubles with others)</td>
<td>Routine is good Getting used to the system feels easy</td>
<td>Very comfortable to drive. Feel more responsible when driving for the municipality. Feels good driving</td>
<td>N/A</td>
</tr>
<tr>
<td>Planning User/ Occasional Needs</td>
<td>N/A</td>
<td>N/A</td>
<td>Works well Routine</td>
<td>The first cars were quite hard to drive, now they feel easy Too many procedures!</td>
<td>Feel responsible to change the remaining booking to let others use it.</td>
<td></td>
</tr>
<tr>
<td>Instant User/ Instant Needs</td>
<td>No need to stress if a vehicle is not available. Can substitute.</td>
<td>Book with margin so as not to overuse Frustration with the cars standing in the parking space even though they are booked.</td>
<td>Finally away!</td>
<td>Feel more responsible when driving pool cars Miss some smaller vehicles Helps me to drive legally (not speeding).</td>
<td>Important not to feel under surveillance Check more carefully</td>
<td></td>
</tr>
<tr>
<td>Needs</td>
<td>Planning User/ Regular Needs</td>
<td>Need to have registration before and driving licence Need to integrate planning in my calendar</td>
<td>Available service support- calling center! Need the car filled/ditched fully before using it</td>
<td>Need to show others how it works More efficient maintenance of the vehicles Make it easier for us who use it often</td>
<td>Need a key with remote control Parking permission is desired for the whole municipality Need to have car filled/ditched 1/4</td>
<td>N/A</td>
</tr>
<tr>
<td>Planning User/ Occasional Needs</td>
<td>Depends on the project’s meeting needs</td>
<td>N/A</td>
<td>Show others how it works while driving it yourself</td>
<td>Need a key with remote control Parking permission is desired for the whole municipality</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Instant User/ Instant Needs</td>
<td>No plan in advance. Need a car available right away.</td>
<td>N/A</td>
<td>Need to help others understand how to use it and drive the cars</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>General Needs</td>
<td>Integrate planning in the Outlook or similar, where all schedules can be visible and coordinated with personal agendas Be able to book and go!</td>
<td>Integrate planning in the Outlook or similar, where all schedules can be visible and coordinated with personal agendas Be able to book and go!</td>
<td>Be able to choose your own code Be able to report fast if something is wrong Could use the entry card for driving Need to have car filled/ditched at least 1/4 Identify the vehicle in different way than registration number</td>
<td>Get info in some of the cars about speed regulations Avoid traffic queues Automatic gearing Call center with fast access</td>
<td>To not spend time filling the tank Simple way to end booking One-click button in the system to end booking earlier than planned</td>
<td></td>
</tr>
</tbody>
</table>
4.2.2. Users’ Behavior

Despite the differences among the workshop members, three different type of users could be identified from the workshop discussions and mapping process. These three user types are determined based on their mobility/travel behavior patterns shown throughout the mapping process (see Behaviors in Figure 7). These users have been clustered into a) planning users with regular mobility needs –Persona 1, b) planning users with occasional mobility needs – Persona 2, and c) instant users with instant mobility needs –Persona 3. This clustering enabled the identification of needs and experiences that are representative of larger group of users rather than focusing on each individual need. The behaviors, experiences, and the needs of each user group vary but in terms of individuals some showed similar patterns, as such it was possible to cluster them into three major groups.

For instance, the planning users with regular mobility needs are those who know about their work activities in advance and thus plan car sharing use well in advance for longer period i.e. one week in advance. Those users, based on the workshop results, tend to need a car regularly and thus book in advance the dates and times of use. These users are the heavy users of carpooling service present at Botkyrka Municipality. The use of the system for them is a routine and this may imply that they are quite familiar with such service. An interesting behavior pattern derived from these users is their sense of responsibility to how much they use the municipality’s carpooling service. For example, some participants constantly mentioned the booking time as a constraint to use carpooling since some had experience of finishing their activities earlier than planned, while their booking time of a vehicle continued. In the discussions, it was noted that they have a strong desire to not over use the service when not needed and leave space for others to book the cars.

The planning users with occasional mobility needs show similar behavior to the first group. However, despite their planning routine, they do not need a car regularly. They plan work activities in advance as well and when the need for car arises they book in advance i.e. two days or a day before. In contrast to the first user group, these users tend to book for shorter time i.e. 2-3 hours maximum. Nevertheless, they tend to check the vehicle availability on a regular basis to make sure they are informed in advance if a car may not be available. A characteristic of these users’ behavior is to extend booking or the use of the vehicle in an unpredicted manner i.e. doing some additional activities on the way back to the office etc.

\[11 \text{ N/A= not available, missing input from the users} \]
On the other hand, the instant users with instant mobility needs have different behavioral patterns. These users do not plan in advance due to their job and activities at work, but have usually instant need for mobility. In the workshop, these showed to be the ones who use their private car mostly for work meetings or activities, due to their perception of not being able to secure a vehicle right away. The instant users tend to check availability and book right away in that moment. Their use of vehicles is more unpredicted in terms of the time they may need a car i.e. it can be an hour and up to a whole day, which is highly dependent on the job activity. Since these users take their private car to work, in case of not available pool vehicles, they use their own car during office meetings as well.

In terms of journey behavior, the participants all revealed similar behaviors with regards to how they interact with the system, the service, and the vehicles. This may indicate that the behavior of users is influenced by the service offering itself. Depending on how the service is designed, the users, over a longer period of time become accustomed to it and react upon what is offered. This can be noted by the answers of the participants when asked how they book the service, how they acquire information about their booking, the vehicle use, and post travel behavior. For example, all of the participants book the vehicles through their computer via web. Before each use, they receive a booking email with information they need to access the car, which they use to identify the vehicle and open it. After use, all of them bring the vehicle back to the same parking place. Another factor might be that the users’ familiarity with the service, whereby behavior patterns of their early (first experience) use of the service may have diminished and harder to reveal during the workshop.

4.2.3. Users’ Experience
Throughout the discussions in the workshop, a general positive attitude toward car sharing was noted among the participants. The results show that the participants all share a positive experience when it comes to using car sharing for their mobility needs. For them, car sharing has become a routine which they have integrated into their work life. However, in terms of the journey itself when using car sharing, some participants relate their experience with technical issues regarding the service. For example, they feel much more responsible when using car sharing rather than their private cars and the size of the vehicles creates for them a perception of stronger responsibility toward the car. Additionally, such responsibility is also felt when they book the service but not use it fully. The users show concerns regarding the booking time, which is strongly related to their values but also attitudes at work i.e. feeling responsible when booking more than needed or being very economic by not making unnecessary expenses considering that it is the taxpayers’ money being used. The sense of community (in the municipality) was shown by all of the participants indicating that they become concerned when cars are booked and not used, or if they are overused. On the other hand, such experience lead them to ask for more flexibility in terms of booking, cancelling, or extending the use.

4.2.4. Users’ Needs
When clustering the individual needs, some similar patterns can be observed among the user types. For example, the planning users with regular mobility needs reveal the need for a more integrated booking system, which is responsive to their personal schedules. They move from one office to another many times throughout the week, in which most cases, these users prefer a car as mode of transport regardless if it’s private or municipality’s car sharing. Being regular users, they want to have more flexibility and easier system when it comes to booking and travel time using car sharing. An interesting outcome shown in the mapping process is the need to communicate to others how the system works. The regular users revealed that they tend to show others how to use the system and how to use the car in some cases. In
addition, the regular users also pointed out at the vehicle fuel (current carpooling they use) as a concern since it takes them time to fill the tank and sometimes the cars are not fully fueled. Users highlighted maintenance and parking of vehicles in various designated areas as well. Therefore, specifying their need for cleaner vehicle and the need for more parking spaces around the municipality. Whereas the planning users with occasional mobility needs are more concerned about the availability of the vehicles if a need arises. Their needs are not always immediate but they want to perceive that a vehicle will be available for them in the right time. These users show a need for information on the availability of the cars effectively communicated to them. Indeed, looking at the needs of the users in terms of the journey, similarities between user types can be noted i.e. the need for a key with remote control for instance, which was shown among these two user types. Currently, when using car sharing, they access a key in the car with a given pin code, which some of the users do not prefer since they need to write it down before every departure. The instant users with instant mobility needs, however, differ from the above user types. These users have unpredicted needs for a vehicle to perform arising job activities. They show the need to check availability of the car in real time and book instantly for a short period. Nonetheless, the instant users may need to extend booking unexpectedly, thus, they also show the need for flexible system where such extension or in the event of shorter booking, can be done easily through calling, mobile app, or computer.

Despite the attempts to explore each individual need, it is extremely complex to design a service that can simply cater to all these needs. As such, the mapping process and the discussions in the workshop enable a holistic representation of the needs that relate to a larger group of users. Seeing the holistic picture of the participants’ journey in a map allowed for categorizing the needs at different stages of the process where common aspects among users were found. These are presented at the end section of the user’s journey map (in Figure 7) as ‘general needs’, which summarize similar needs observed among all participants.

<table>
<thead>
<tr>
<th>General User Needs</th>
<th>RESEARCH AND PLANNING</th>
<th>BOOKING</th>
<th>PRE-TRAVEL</th>
<th>TRAVEL</th>
<th>POST-TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated planning in the Outlook or similar, where all schedules can be visible and coordinated with personal agendas</td>
<td>Be able to cancel without additional charges</td>
<td>Be able to choose your own code</td>
<td>Get info in some of the cars about speed regulations</td>
<td>To not spend time filling the tank</td>
<td></td>
</tr>
<tr>
<td>Be able to book and go!</td>
<td>Booking system for regular use</td>
<td>Be able to report fast if something is wrong</td>
<td>Avoid traffic queues</td>
<td>Simple way to end booking</td>
<td></td>
</tr>
<tr>
<td>Show in advance how to use the system and the car</td>
<td>Booking system for occasional/instant use</td>
<td>Could use the entry card for driving</td>
<td>Automatic gearing</td>
<td>One-click button in the system to end booking earlier than planned</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7. General user needs derived from the mapping process during the workshop with users

4.3. Workshop III

In the final workshop, all the actors in the LEV-pool project were invited to participate. Not all the stakeholders were present, whose perspective would have added much more input to the workshop activity. The participants were presented with the findings from the two workshops and a discussion followed, whereby key concerns were being pointed out by each of the stakeholders. The workshop resulted in insightful perspectives about major challenges and concerns regarding the users and the service, while each stakeholders’ role was identified. Below, the stakeholder map with users at the center is presented. Referring from the central theme ‘user’, the first ring shows the main concerns identified by all participants.
The second ring from the center presents the specifications around the concerning issue. And finally, the last third ring shows the main stakeholders as role players in that area.

As seen in the map above (Figure 9), five main service aspects regarding the users’ interaction with LEV-pool were identified as more critical. These are booking, communication, the vehicle, the service overall, and the brand. Among all these aspects, an important one is communication in terms of how LEV-pool will reach to users before testing period and also during the testing phase. With consideration to LEV-pool being an innovative concept in the car sharing market, it becomes imperative to design communication strategies that reach the users effectively. Referring to the map above, in the third outer ring, some aspects regarding communication are revealed i.e. approaching test users with the idea that they are ‘chosen’ or aiming at touching upon the sense of community noticed throughout Botkyrka Municipality. Such communication can be even strengthened by using the KTH brand as reliable and credible image to convince users. The role of project partners is highlighted here in collaboration with the research center at KTH as main stakeholders together with Botkyrka Municipality as the direct stakeholder communicating to its employees. Another significant aspect that may be a challenge for the project is the vehicle itself. Considering LEV-pool will deploy light-weight electric vehicles, their operation system differs from ordinary vehicles. Informing users in advance while showing them effectively how the vehicle works may tackle the issues arising from the vehicle design i.e. the comfort of driving a Twizy car. Here, Renault’s role was pointed out in terms of the considerations they shall make about the vehicle functioning system. However, since none of the Renault representatives were present in the workshop, it is hard to estimate if they may consider making changes to the vehicle in the long run. In addition, throughout the map, the role of Hertz can be seen as key in many aspects concerning the users. Hertz will provide the front-end user interface and mainly all what users will experience when using the service. As

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such, it is important that all other stakeholders communicate with Hertz about issues concerning users.

On the other hand, when placing the service at the center of the map, different issues arise regarding the service for which stakeholders’ role is crucial in terms of tackling problematic areas. The map below (Figure 10) presents the service centered stakeholder map which resulted from the workshop activity. Here, four main concerning areas regarding the service are pointed out from the workshop results: the use of the service, the allocation of resources, the booking system or interface, and part of the LEV-pool concept --the ‘parent’ user. For instance, a critical aspect in terms of service use pointed out is the overuse of the system during the testing phase for being free of charge. The stakeholders are concerned about this aspect due to the effect it may have on the ‘availability’ factor if some users book a vehicle for much longer periods. This aspect was also pointed out in the first workshop, where a suggestion is to limit booking time or create a perception to users that the service is part of a community value for which everyone shall have access.

Figure 9. Service centered stakeholder map
5. Discussion

The results presented above provide a holistic understanding of the users, their needs, behaviors, and experiences and the service requirements resulting from exploring these user dimensions in the context of LEV-pool and Botkyrka Municipality. The findings suggest that users have distinct needs for mobility (at work), which are shaped by the external factors such as work activities and job occupation. The underlying user dimensions explored throughout this thesis show as relevant in shaping the users’ evaluation of a service and their decision to use a certain mobility alternative.

5.1. Users

The findings suggest that car sharing users in the context of Botkyrka Municipality are middle age individuals, low gender distinction, who live a fairly short distance from their workplace. These users have multimodality travel behavior when commuting to and from work, whereas at work they mainly prefer car (private or car sharing) due to flexibility and convenience. There are both occasional and regular needs for mobility, which depend on their work activities and job occupation. These users are environmentally concerned and cautious about finances (public resources in this case since car sharing is offered through the municipality). A peculiarity of these users is their after-work activities, for which they justify their behavior of taking private car to work. In the broader car-sharing context, these user characteristics resemble the findings of Huwer (2004), Katzev (2003), Koch (2001) and Shaheen et al. (2004). Research also shows that the car sharing users tend to drive less, are environmentally concerned, and are open minded about innovations (Huwer 2004, Katzev 2003, Koch 2001). In Botkyrka Municipality, however, there are both users who drive often and users who drive less but this factor has not been observed in the scope of this study, whereby conclusions cannot be drawn solely on observations. Though, the environmental awareness was shown during the discussions and this related also to the environmental policy goals that Botkyrka Municipality promotes. In terms of openness toward innovations, although perceived as positive when participants were introduced with the LEV-pool vehicles, conclusions cannot be made based on the scale of these workshops since these were not explicitly mentioned.

5.2. Users’ Needs

For the (prospective) LEV-pool user, the customer journey map reveals the need for:

- easy access of information,
- simple booking system
- fast access to the vehicle and available vehicle,
- service support,
- instructions and guidance on system use,
- motivational feedback

For the users at Botkyrka Municipality, the persona map points out three different type of users who show planned behavior and have different needs for car sharing service. Those users, who plan ahead their activities at work, tend to have regular and occasional needs for mobility. Whereas those whose job occupation involves a lot of field work for instance, tend to have instant needs for mobility. The findings here suggest that mobility needs at workplace are highly shaped by the external factors such as work activities or job position of the individuals, which also determine the frequency for mobility. Considering that membership duration in a car sharing program does not imply higher frequency of use as concluded by Habib et al. (2012), for car sharing as business, workplaces where inter-office activity is high
can be of higher interest for setting up such service. An interesting factor pointed by users, however, is that the decision to take a private car to work is also slightly affected by their need to perform work activities rather than their need to commute every day to work. Such observation may pose implications for the concept of LEV-pool itself when considering these underlying factors of how people’s needs for mobility emerge.

In terms of car sharing service, these users can be grouped as regular, occasional, and instant users. Regular users have the need:

- for a more integrated booking system, which is responsive to their personal schedules,
- more flexibility and easier system when it comes to booking and travel time,
- to communicate to others how the system works,
- to have charged vehicles,
- for maintenance of vehicles, and
- more parking spaces around the municipality

The occasional users have the need:

- for available vehicles with short notice,
- for information on the availability of the cars effectively communicated to them,
- for a key with remote control (observed in other users as well)

Whereas the instant users have the need:

- to see the availability of the car in real time,
- for instant booking option,
- to extend booking, and
- for overall flexibility of the system

Since LEV-pool intends to have two groups of users –daytime and morning/evening users, these results can help in identifying which user profile in terms of type of need best fits to these targets and expand customer usage. These findings imply that each of these user groups expect to have a service that caters to their specified need and this is strongly indicated in the user’s needs for different booking system, for instance. In such regard, Shaheen et al. (2004) found out that user satisfaction with booking system does affect the use of such services. Therefore, designing a service that focuses on different user needs may lead to a higher usage rate.

5.3. Users’ Behavior
The findings reveal differences in users’ behavior with regards to car sharing service. The major difference captured between the two workshop results is the behavior of users and how they interact with car sharing service to satisfy their needs. For real users (current users of car sharing), the service use behavior is much simple and a routine behavior compared to the LEV-pool prospective users, which show much complex behavior. One reason is that the participants at the second workshop are already car sharing users, which may indicate their behavior is partly influenced or guided by the service offering itself i.e. go to website and book a vehicle, and partly because they use it often and thus become accustomed to a certain behavior. Whereas for the LEV-pool users, this complexity may be related to the project’s service approach such as the ‘parent’ users, for whom the behavior is ‘enforced’ by the service itself i.e. bring the car to work every morning and pick it up in the evening at the agreed time. Nevertheless, if those results are to be interpreted in terms of general mobility behavior, they indicate that mobility behavior is affected by the availability or the ‘perceived’
availability of transport mode and distance from workplace to the next destination. Which mode is available and offers the most flexibility and convenience in constrained-time situation, the users go for that choice. The ‘availability’ factor has been strongly referred in other studies mentioned in this thesis as an important indicator of using car-sharing service (Boyaci et al. 2013, Koch 2001).

5.4. Users’ Experience

The results suggest that the experiences of users differ depending on the type of user i.e. regular, occasional, or instant user. A major insight correlating to all user types is how users relate their experiences with technical aspects of a service offering i.e. unavailable vehicles or not fueled/charged fully vehicles which correlate to other studies findings as well (Boyaci et al. 2013, Bruglieri et al. 2014, Luca & Pace 2015). These aspects seem to take place in the user’s overall evaluation of their experience with a service. Thus, indicating the importance of considering every service component as an additional experience offered to the user, which is evaluated by the user as a whole. In terms of emotional patterns when using car-sharing services, the results reveal the sense of responsibility in terms of the frequency of usage, booking time, and driving car sharing vehicles. These contradict with Schaefers (2013) findings that car sharers attribute their use to the sense ‘no responsibility’ and ‘no worries’. This sense of responsibility for users at Botkyrka Municipality may relate to the reason that car sharing is offered by the municipality for its employees implying the concerns that these users show when using public resources (taxpayers’ money). Despite showing different positive and negative experiences throughout their journey, users seem to have an overall positive attitude toward car sharing. Car sharing for these users relates a sense of community, which is highly present at this workplace. Employees feel responsible of their actions involving public resources i.e. not overusing the municipality’s carpooling despite their high needs for vehicle. Such overarching attribute correlates to the findings of Schaefers (2013), where he describes this as motivational pattern encompassing a sense of belonging to a group. But also the climate goals and environmental policies of Botkyrka Municipality might have a strong effect in how employees satisfy their mobility needs at work, for which Schaferes (2013) relates in his study as a value for car sharing users who are concerned about sustainability in terms of environmental issues.

5.5. Service Requirements

The service design methods integrated in the workshops reveal key service components affected by the user dimensions explored. The significance of the service requirements lies in the user-centric aspect from which they are derived. By exploring the users, the results point directly to different requirements that the service shall meet for it to enhance usage. These service requirements can be interpreted as both opportunities but also as challenges and problematic areas for the design of electric mobility services. The findings suggest these service requirements based on user’s perspective:

- available vehicles at the needed time
- simple and easy booking system with many features responsive to users’ needs,
- maintenance and cleanliness of vehicles
- effective communication of service offering,
- simple pricing schemes

The workshop findings propose similar service requirements to what literature studies suggest as well and mentioned throughout this thesis (Habib et al. 2006, Huwer 2004, Koch 2001, Luca & Pace 2013, Shaheen et al. 2011, Shaheen & Cohen 2007).
The third workshop was an effective way to communicate these issues to the project stakeholders by identifying each role player in each issue so that every critical component of the service can be addressed. Sharing these issues among all stakeholders in large-scale project such as LEV-pool is highly important in order to create more effective strategies that can eliminate areas leading to user dissatisfaction. The results from the third workshop suggest critical user and service areas where major focus is required for the design of a sound car sharing system. Reflecting upon the service requirements mentioned above, the concerning issues in terms of users are regarding booking, communication, the vehicle, the service offering, and the brand. Whereas concerning issues in terms of the stakeholders regarding the service provision are the use of the service, the allocation of resources, the booking system or interface, and part of the LEV-pool concept. Shaheen et al. (2004) points out in a post-evaluation of a testing period for a similar concept to LEV-pool, that problematic service areas should be accounted even if a concept is being only tested. Users may create first impressions already, which can affect their evaluation of such service even after improvements are made (ibid.)

5.6. Summary
The results discussed above gave an understanding of what this thesis intended to look into: the users, their needs, behaviors, and experiences in relation to LEV-pool project. Capturing and presenting in detail intangible user dimensions provides significant information for the service designers to develop more desirable, usable, and sustainable services. Using service design methods enabled the derivation of deeper understanding of the users in the actual context of LEV-pool for which a generalization cannot be made while referring only to the literature studies on the users. This is partly because users differ from place, context, and culture and not necessarily similar innovations may spread in the same manner everywhere. Considering that the intention of LEV-pool project is to offer a sustainable mobility alternative at the workplace, this implies that such innovation shall aim at addressing the actual needs of the users while tackling urban issues i.e. fossil fueled private car commutes at large workplace.

Exploring users and service requirements through service design methods, shows to be an effective approach which provides analysis of the intangible user dimensions such as needs, behaviors, and experiences beyond the quantitative demographics. This is particularly important for the design of services, mobility alternatives through car sharing systems in this thesis, to be desirable, useful, and sustainable. These user dimensions do affect the user’s evaluation of a service or product, influence their choices, and shape their decisions to use or not a certain innovative alternative. Therefore, it is paramount that service innovations and particularly innovations that aim at tackling challenging issues of sustainability such as mobility and transport, to focus on the users as the critical driving force of diffusing these solutions toward larger acceptance and usage.
6. Conclusions, Study Limitations, Recommendations and Further Studies

6.1. Conclusion

This master thesis explores the users and the service requirements with regards to electric mobility innovations by taking on a user-centered service design approach. The objective of this thesis was to develop a visual mapping of the users’ needs toward LEV-pool car sharing service concept and service requirements resulting from these needs respectively. Compilation and analysis of literature studies allowed for a broader understanding of car sharing systems, service models and design approaches, while pointing at challenges related to designing electric car sharing and critical areas that may lead to user dissatisfaction. Additionally, looking at user research studies, offered a foundation about users and their characteristics, behaviors, attitudes, motives, and their expectations about car sharing. On the other hand, service design approach provided an effective framework to derive qualitative insights and knowledge about the users beyond the existing demographics. Integrating these methods into workshops with different focus groups shows to engage participants into deep discussions and stimulate sharing of experiences and behaviors, and other intangible variables, which may not be revealed using only surveys or interviews.

In the context of sustainable mobility innovations such as car sharing, this thesis highlights the findings from the literature that users’ needs differ in terms of place and car sharing approach. Although, some similar patterns among users’ needs in other places and context are noticed i.e. simple service offering in terms of booking, easy access to vehicles, and simple payment procedures. For electric car sharing services targeting large workplaces and short way commutes, this thesis reflects upon investigating the external factors affecting the mobility needs of users to understand their specific needs. In this context as such, to design sustainable mobility services such as electric car sharing, it is imperative to look upon the users that each car sharing operators intend to target so as to increase the use of such service.

In the context of service design for LEV-pool project, the methods used reveal concrete service requirements that resulted from the exploration of users and underlying dimensions such as needs, behaviors, and experiences. These can be summarized as: available vehicles at the needed time, simple and easy booking system with many features responsive to users’ needs, maintenance and cleanliness of vehicles, effective communication of service offering, and simple pricing schemes.

Finally in the context of LEV-pool project, a detailed overview depicting both (prospective) users and actual users of car sharing at Botkyrka Municipality has been presented encompassing the users, their needs, behaviors, and experiences with regards to using electric car sharing. The findings point at different user types with distinct purposes of using car sharing, whose needs are affected by other external factors. Their mobility behavior differs in terms of how they interact with car sharing service and is affected by the service offering. In general, users show mixed experiences toward car sharing systems, and many relate it to technical aspects of the service. These results suggest that every service component or configuration triggers an experience onto the user, therefore highlighting the importance for detailed service design.

These findings give a holistic picture of the users and intangible dimensions as relevant determinants affecting users’ decision, which service designers can use to configure and support better service design for car sharing systems that aim tackling issues of mobility and sustainability.
6.2. Study Limitations

When conducting user research, and interpreting data, there are limitations that ought to be considered. First, this master thesis presents only an exploratory research based on qualitative user-centered service design methods, which are applied and interpreted as direct observation of the users in focus groups. Despite the ability of these methods to derive qualitative insights onto the users and intangible dimensions, given the number of workshops conducted with focus groups—one workshop with actual users, they do not allow for any quantitative inference that may lead to a statistical sense about all users at Botkyrka Municipality or beyond. Therefore, this thesis represents only a first step toward understanding the users of car sharing in the context of Botkyrka Municipality and LEV-pool project, which other researchers, designers, or car-sharing operators may use as insights or starting point to develop user-centered services.

Second, the applied methods in this study propose some limitations. As stated by design researchers and practitioners, there is no set theoretical foundation in the field of service design that pinpoints to methods that unveil significant discovery (Akama 2009, Evenson et al. 2010, Evenson & Dubberly 2010, Goldstein et al. 2002, Kimbell 2009, Moritz 2005). Rather, these methods are seen as tools that show to be effective and popular approaches to understanding users with regards to designing services (Stickdorn & Schneider 2010). These tools can be used in any combination with other existing service design tools depending on the project approach, therefore, implying that there may have been other combinations to explore user dimensions, which could not be evaluated in the scope of this study. The methods in this thesis were selected based on the aims of the thesis—exploration, for which service design approach suggests what methods to integrate in this phase of the research process.

Third, the data derived in this thesis may not be applicable to different contexts than electric car sharing approach that resemble LEV-pool. This thesis intended to contribute particularly to user knowledge specific to the LEV-pool project approach, where analysis has been also made in this context. Therefore, the study may be limited to electric car sharing approaches targeting workplaces and in Sweden, and not generalized further.

6.3. Recommendations and Further Studies

In terms of the LEV-pool project, some recommendations can be drawn from this study for further analysis of users:

I. Research into the intangible aspects of non-car sharing users and their mobility patterns to understand the potential for diverging a larger group of people into shared-use systems.

II. Look into the external environment more extensively to understand how needs for mobility emerge and how it can affect the decisions of (prospective) users.

III. Perform similar mapping process to this thesis after the testing period with actual users to determine the behaviors and experiences of users when actually using LEV-pool, which can be effective for service improvements and modifications.

On a broader research context, focusing on user research may bring valuable insights for further innovations in electric mobility. For instance, experience innovation which specifically focuses on users’ experiences when using a certain product or service, is what many researchers are contemplating on to upscale the customer acceptance and usage of innovative ideas (Kraft 2012). Investigating onto the experiences of car sharing users and non-car sharing users could potentially unveil effective design strategies to expand the use of electric mobility innovations.
In addition, future studies can draw upon user research to search for opportunities to diversify the electric mobility market further. One direction could be investigating on integrating electric mobility into the range of public transport services by incorporating smart technologies for building on such systems.
7. Acknowledgements

Foremost, I would like to express my sincere gratitude to Peter Georén, the director of Integrated Transport Research Lab at KTH Royal Institute of Technology for involving me in the LEV-pool project research and his immense support during this time. Thanks to him, this thesis was made possible and such involvement has led to an array of fortuitous encounters with people who have inspired me but also influenced the course of my academic career and pursuit.

In the same manner, I want to show my genuine appreciation to my supervisor, Sofia Ritzén, Associate professor Integrated Product Development at KTH Royal Institute of Technology, for her guidance and invaluable feedback throughout the whole period of my research. Her support gave me more confidence to continue further and stand for my aims.

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I am immensely thankful to my family for their patience, encouragement, and motivation during this period. I dedicate this work to my dearest mother Sanije and father Ali for they are my inspiration to persistently acquire knowledge.

Finally, a big thank you to my friends and colleagues: Jan Cihlar, Martha Mancheva, Enkhtuya Bold, and Brikena Meha for bearing with me and their empathy throughout this period.
8. References


9. Appendices
8.1. Personas generated from the Botkyrka Municipality Travel Survey data used in the first workshop

PERSONA 1

Imaginative Name: Niclas
Age: 52
Occupation: High official at Samhällsbyggnadsförvaltningen (SBF)
Education level: Highly educated

Travel Habits

Niclas is a high-end professional at samhällsbyggnadsförvaltningen (SBF) department and is quite a busy person. His occupation takes a lot of his time and he spends a lot of his working time in meetings.

He lives in a private villa just 8 km away from his workplace. He has a moderately high income and makes a good living.

Niclas drives to work every day by his car. He thinks that he does not have time to wait for buses and they are not frequent. In addition, he always needs a car at work since he has many meetings to attend in different offices. Often, municipality cars are not available, but also using them is not compensated all the time. To use the public transport, Niclas would be late in all meetings, and biking to the meeting is almost impossible because office locations are far from each other. He does not want to sweat and hurry to an office. He would like to use a bike sometimes, but that is not provided and he can’t always transport his personal bike to work since he uses it occasionally at home. Thus, he prefers his own car which gives him full flexibility, despite sometimes he spends some time finding a suitable parking.

Niclas is aware of the environmental issues with cars but he will not change his behavior if public transport improves, or parking fees increase, and less spaces become available for his car. He does neither prefer public transport for his journey to and from work, and neither can use a bike to work since he lives a bit further which would take him a lot of time. He is willing to spend more just not to waste his valuable time.
PERSONA 2

Imaginative Name: Anna

Age: 34

Occupation: Job trainee at Socialförvaltningen (SOC)

Education level: Well educated

Travel Habits

Anna is a job trainee at Socialförvaltningen (SOC) department and she is quite busy since there are many of trainings happening at work and in different locations. She is a mom of two and tries to spend most of her weekends with her children in the country side, in parks, and often trying to do all the shopping in weekends.

She lives quite close to her workplace, just 3 km away. She shares a car with her husband, although most of the time her husband uses the car since he works in a more distant place. Though, she does not need the car so much since she uses mostly her bicycle to work or public transport. Sometimes she even walks to there as she enjoys it when the weather is nice. However, there are times when she really needs the car during work since her trainings require much planning and organization in between various places. Using public transport during those times is not convenient at all for her since it takes too much of her time and often there is no bus for her locations. Although, she may use the office car, she needs to book it in advance and not all the time she can have it when she needs it.

Anna would use an alternative such as carpooling if it was available as that would be a very convenient choice for her, where she wouldn’t have to coordinate in advance with her husband and because she thinks she does not really need a car for commuting to work.
PERSONA 3

Imaginative Name: Tim

Age: 27

Occupation: Accountant at kommunledningsförvaltningen (KLF)

Education level: Well educated, Master degree in Financing

Travel Habits

Niclas is an accountant at kommunledningsförvaltningen (KLF) department and is an energetic worker. Although work takes a lot of his time, he manages to do lots of sports as well. He goes to gym regularly. He is very keen to innovations and ‘trendy’ things.

Tim lives with his girlfriend in a flat just 5 km away from his workplace.

Tim does not think too much about his journey to work since he uses different ways to go there depending on time availability, and weather. Most of the time he uses public transport as he thinks is better but also he does not have a car to drive. Sometimes, when is not rushing, he uses his bike which he really enjoys riding. But, not always he can manage to take the bike since it is not as fast and he needs to wake up much earlier to get to work. Similar happens with public transport but at least he can read news on the bus or maybe read a book, and if it’s a bad weather, using public transport is his best choice. Sometime he wishes he had a car that would make it much easier for him although he does not prefer fossil fueled cars.

At work, Tim uses his bike for most business trips, or takes the bus but that is rare since it is not convenient at all. Tim would be happy if other alternatives are available and affordable where he does not have to plan in advance.

8.2. Raw data from the mapping process in the first workshop
<table>
<thead>
<tr>
<th>Stages</th>
<th>User</th>
<th>Research and Planning</th>
<th>Booking</th>
<th>Pre-Travel</th>
<th>Travel</th>
<th>Post-Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOING</td>
<td>Persona 1</td>
<td>Plan the week in advance</td>
<td>Use computer or app in the smartphone to book</td>
<td>Look for information for the car availability</td>
<td>Change booking if car is damaged</td>
<td>Park and lock the vehicle for a short time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Search for information about your LEVpool car</td>
<td>Check for confirmation that the booking has been made</td>
<td>Check booking if car is damaged</td>
<td>Find the way (navigation)</td>
<td>Park it back in a slot designated parking space</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Find the weather/Get the decline app</td>
<td>1-2. Booking information for availability for 1 or 1 day (depending on schedule)</td>
<td>Find the nearest service station</td>
<td>Bring belongings (i.e., how the car</td>
<td>Make sure nothing is left in the car</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stop at the service station</td>
<td></td>
<td>Get the access card for the car</td>
<td>Get the access card for this time</td>
<td>One feedback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wait for information on the next steps</td>
<td></td>
<td>Check battery status</td>
<td>Adjust mirror &amp; chair</td>
<td>Go to the office and share experiences with others</td>
</tr>
<tr>
<td></td>
<td>Persona 2</td>
<td>Change the vehicle every day</td>
<td>Book the car to use after drop-off if needed</td>
<td>Change booking if car is damaged</td>
<td>Start engine</td>
<td>Take the car from designated parking and go home</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check safety</td>
<td></td>
<td>Find the way (navigation)</td>
<td>Drive and avoid the queues and traffic</td>
<td>Plug in to charge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drive to work everyday (obligation)</td>
<td></td>
<td>Bring belongings (i.e., how the car</td>
<td></td>
<td>Make sure it is clean everyday</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Drop off the car at the agreed time and place</td>
<td></td>
<td>Get the access card for the car</td>
<td></td>
<td>Control and report any damages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Make sure everything the car is ready for the next user</td>
<td></td>
<td>Check battery status</td>
<td></td>
<td>Report to person in charge when thorough cleaning/maintenance service is needed</td>
</tr>
<tr>
<td>FEELING</td>
<td>Persona 1</td>
<td>Proud</td>
<td>Fan</td>
<td>Thinking that it is an easy process</td>
<td>Have an impression</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Curious</td>
<td>Sense of status</td>
<td>Afflicted by weather</td>
<td>I will try it out again</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There is a cool thing</td>
<td>Tiring to the cool</td>
<td></td>
<td>Easy and convenient</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feeling closest to the out the service</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KIT label means it better</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I am contributing to environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cool app</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I am doing this because I am asked</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Persona 2</td>
<td>Too much responsibility</td>
<td>Optimistic</td>
<td>Confused</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive and optimistic</td>
<td>Feeling pressured</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sense of ownership</td>
<td>Exhausted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Feeling like an ambassador</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THINKING</td>
<td>Persona 1</td>
<td>Many meetings in between offices</td>
<td>Simple booking system</td>
<td>Vehicle working</td>
<td>Feedback on the CO2 emissions I have saved</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Utility aspect</td>
<td>Easy booking</td>
<td>Be able to park for a short time</td>
<td>Automatic travel reporting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convenience</td>
<td>Confirmation of booking</td>
<td>Reminder or notification for time slot running out</td>
<td>Get confirmation I did the right thing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ronnie at work</td>
<td>To know the car is as soon as I booked it</td>
<td>I forgot my card, what should I do?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Need the car to work from home</td>
<td>Need at car all day</td>
<td>How does the handicap function?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Integrated system in outlook</td>
<td>It’s not starting, what should I do?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘Calendar’ (avatar)</td>
<td>Safety?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>‘When booking matches with my meetings’ schedule</td>
<td>Where do I park?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>How do I pay?</td>
<td>How do I pick the car?</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Can I extend the booking?</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEEDS</td>
<td>Persona 2</td>
<td>Need a car during weekends</td>
<td>The car packed close by</td>
<td>Pick-up Taxify and bring it home</td>
<td>Car available for pick-ups</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Need a car to commute to work</td>
<td>Picture embedded for pick-up info about the battery status</td>
<td>Needs to be informed if Taxify is missing at the pick-up time</td>
<td>Car missing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Being able to get somebody else to drive the car to work in case of illness</td>
<td>Service support contact info</td>
<td>In my ideal home?</td>
<td>Call support</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is the car really charged?</td>
<td>Vehicle working</td>
<td>Am I lucky and doing the right thing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>How do I report issues related to the vehicle?</td>
<td>Be able to park for a short time</td>
<td>Is the car in its place?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOUCHPOINTS</td>
<td>Persona 1</td>
<td>Value the participation</td>
<td>Two button click system</td>
<td>Car available for pick-ups</td>
<td>Car missing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimize the user information</td>
<td>First impression of the system</td>
<td>Car missing</td>
<td>Call support</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incentives for use/use for free</td>
<td>Ask a colleague for help</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Gift for using the service</td>
<td>Easy access to information</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Wearable jacket</td>
<td>Responsive actions (i.e. confirmation mixed)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Person 2</td>
<td>Full-time service employee</td>
<td>Access the car easily</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Charge the car fully</td>
<td>Identify the booked car easily</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Make sure the car is ready for use everyday</td>
<td>Prior-booked reminder</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Channels</td>
<td>Persona 1</td>
<td>Make a buzz (web, print, mobile)</td>
<td>Easy default system</td>
<td>Smart card use</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battery lifetime</td>
<td>SMS and e-mail confirmation</td>
<td>Engine start in sticker</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Data content on information of users</td>
<td>Responsive app/webpage</td>
<td>Interactive media (i.e. interactive video)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Have an extra ‘book’ (parent) for the car</td>
<td>Vehicle-labelling</td>
<td>Information through SMS app, or e-mail</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Make a good first impression for</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Campaign (awards / websites)</td>
<td>1-2. Booking information for availability for 1 or 1 day (depending on schedule)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>KIT for sale</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Optional Test drive (ISO 6356) instead of “Talk to the meeting”</td>
<td></td>
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<tr>
<td></td>
<td>Person 2</td>
<td>Support a friend</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Submit ownership for the ‘Todenvärd’ (parent)</td>
<td></td>
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<tr>
<td>OPPORTUNITIES</td>
<td>Persona 1</td>
<td>Make a good first impression for the system</td>
<td>Instant use for one hour as default system setting</td>
<td>Listed the Taxify car</td>
<td>1-2. Guide (video) sent to first-time users</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Campaign (awards / websites)</td>
<td>Personalized setting with user profile</td>
<td>Listed the Taxify car</td>
<td>Tickets on board with info on different stops</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KIT for sale</td>
<td>Integrate the system with outlook</td>
<td>Personalized setting with user profile</td>
<td>Code/Mobile available in the car</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optional Test drive (ISO 6356)</td>
<td>Remember option for the ‘Todenvärd’ (parent)</td>
<td>Integrated the system with outlook</td>
<td>Bluetooth (free)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Talk to the meeting”</td>
<td></td>
<td></td>
<td>Automatic lock available after a period</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Person 2</td>
<td>Support a friend</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Submit ownership for the ‘Todenvärd’ (parent)</td>
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<td></td>
</tr>
</tbody>
</table>
### 8.3. Participant information from the second workshop

<table>
<thead>
<tr>
<th>User</th>
<th>Age</th>
<th>Occupation</th>
<th>Place of work</th>
<th>Distance (home to work)</th>
<th>How do you go to work? /How does a typical day look for you?</th>
</tr>
</thead>
<tbody>
<tr>
<td>User 1</td>
<td>60</td>
<td>Ombudsman for Children</td>
<td>Kommunledningsförvaltningen, the whole municipality</td>
<td>1.5</td>
<td>Walk to and from work. Use car pool a lot. This week booked 3 times. Commuter train.</td>
</tr>
<tr>
<td>User 2</td>
<td>41</td>
<td>Project Manager Development</td>
<td>Samhällsbyggnadsförvaltningen/Kommunalhuset</td>
<td>4</td>
<td>Travel to and from work by bike / car (depending on season). Meetings, work, mainly in front of the computer. After work, drive by car, take kids to different activities.</td>
</tr>
<tr>
<td>User 3</td>
<td>42</td>
<td>Caretaker</td>
<td>Kommunalhuset</td>
<td>1.5</td>
<td>Car or walk to work, depending on what I have planned after work. After work I usually take the car to the gym, the golf course etc.</td>
</tr>
<tr>
<td>User 4</td>
<td>31</td>
<td>Project Manager Development</td>
<td>Kommunalhuset</td>
<td>3</td>
<td>Travel by car from home to work. Most days I don't do any trips at work. Travel back home by car. Use car to activities.</td>
</tr>
<tr>
<td>User 5</td>
<td>49</td>
<td>Environment and Health Inspector</td>
<td>Samhällsbyggnadsförvaltningen/Kommunalhuset</td>
<td>10</td>
<td>Drive the car och take the train to work (today - car). If I have an inspection, I use the car, public transport or walk, depending on the distance and on the availability of public transport. Drive the car or take the train back home or to some activity - then bus. Go shopping, pick up the kids on the way home, if I have the car.</td>
</tr>
<tr>
<td>User 6</td>
<td>45</td>
<td>Operations Engineer</td>
<td>The whole municipality</td>
<td>2</td>
<td>To work - walk or get a lift. At work - use the work cars effectively 2.5 - 5 hours per day. After work - MC or car to activities.</td>
</tr>
<tr>
<td>User 7</td>
<td>53</td>
<td>Energy &amp; Climat Advisor</td>
<td>Samhällsbyggnadsförvaltningen/Kommunalhuset</td>
<td>10</td>
<td>Mainly use train to and from work. Often use the trains also to go to/from meetings in Stockholm. Use my own car privately quite a lot. Use car pool 2-3 times a month, often to transport things or for trade fairs (Älvsjö/Kista).</td>
</tr>
</tbody>
</table>

### 8.4. Identification of issues regarding LEV-pool mapped during the third workshop
8.5. Questions for discussions

WORKSHOP I

- Questions for Discussion
- What actions are customers taking to meet their needs?
- What are their main behaviors?
- What is their experience? What do they expect?
- What emotions do people have along their journey?
- What are the channels, touchpoints, time and space for customers to satisfy one or more of their needs?
- What are the service requirements from these needs?
- What are the opportunities for the service?

WORKSHOP II
• Name
• Age
• Occupation
• Place of Work
• What actions/activities do you take/do to go to work and come back? Describe your behaviors?
• Can you describe your feelings and emotions along your journey?
• What it is that you need most along your journey? What do you usually think during the different stages?
• What do you think about car sharing?
• What do you like/dislike about them? What is good/bad about the service?
• How does it feel to be a user of car sharing? What is your experience?

WORKSHOP III

• What are the current issues/challenges concerning each of the stakeholders based on the workshop I and II findings?
• Which are the concerning issues from users’ perspective?
• What are the specifications of each concerning issue?
• Which stakeholder is responsible for these issues?
• What are the challenging issues from the service point of view?
• What are the specifications of each challenge?
• Which stakeholder is responsible for these issues?